Final

Interim Record of Decision Amendment

For

Southeast Industrial Area (Operable Unit 1)

Of

Anniston Army Depot Anniston, Alabama

October 2014

U.S. Army Corps of Engineers Mobile District

FINAL
INTERIM RECORD OF DECISION
AMENDMENT

FOR

SOUTHEAST INDUSTRIAL AREA
(OPERABLE UNIT 1)

OF

ANNISTON ARMY DEPOT
ANNISTON, ALABAMA

Submitted to:
U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT

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ACRONYMS

ADEM	Alabama Department of Environmental Management
AEC	Army Environmental Command
ASA	Ammunition Storage Area
ANAD	Anniston Army Depot
ARAR(s)	Applicable or Relevant and Appropriate Requirements
BEHP	bis(2 ethylhexyl)phthalate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information System
CDI	Chronic Daily Intake
CGW	Combined Groundwater
CFR	Code of Federal Regulations
COCs	Chemicals of Concern
COPCs	Chemicals of Potential Concern
CWS	Coldwater Spring
DERP	Defense Environmental Restoration Program
DNAPL	Dense Non-Aqueous Phase Liquid
DOD	Department of Defense
eGWIS	Enhanced Groundwater Interceptor System
ECLR	Excess Lifetime Cancer Risk
EPA	Environmental Protection Agency
EPC	Exposure Point Concentrations
ESA	Endangered Species Act
FFA	Federal Facility Agreement
FFS	Focused Feasibility Study
FS	Feasibility Study
GAC	Granular Activated Carbon
GPD	Gallons Per Day
GRAs	General Response Actions
GWIS	Groundwater Interceptor System
HHRA	Human Health Risk Assessment
HI	Hazard Index

HQ	Hazard Quotient
HSU	Hydrostratigraphic Units
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IROD	Interim Remedial Action Record of Decision
IWTP	Industrial Wastewater Treatment Plant
JEM	Johnson and Ettinger Model
JFZ	Jacksonville Fault Zone
KWTP	Krebs Water Treatment Plant
LTM	Long Term Monitoring
LUCs	Land Use Controls
MBT	Molecular Biological Tools
MCLs	Maximum Contaminant Levels
MCLGs	Maximum Contaminant Levels Goals
MNA	Monitored Natural Attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	Polynuclear Aromatic Hydrocarbon
PCE	Tetrachloroethene (Also Known As Perchloroethene)
POUT	Point of Use Treatment
PPE	Personal Protective Equipment
PPRTVs	Provisional Peer-Review Toxicity Values
PS	Pygmy Sculpin
PSMR	Partial Source Mass Removal
RAOs	Remedial Action Objectives
RD	Remedial Design
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RI	Remedial Investigation
RfCs	Reference Concentrations

RfDs	Reference Doses
ROD	Record of Decision
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act of 1986
SFs	Slope Factors
SIA	Southeast Industrial Area
SMCLs	Secondary Maximum Contaminant Levels
STP	Sewage Treatment Plant
SWMUs	Solid Waste Management Units
TCE	Trichloroethene
TM	Technical Memoranda
URFs	Unit Risk Factors
US	United States
VI	Vapor Intrusion
VOCs	Volatile Organic Carbons

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

Anniston Army Depot (ANAD) is an active military facility located in Anniston, Calhoun County, in northeastern Alabama. The Southeast Industrial Area (SIA) occupies approximately 525 acres on the 15,319-acre installation. Facilities and operations in the SIA support the installation's mission of the refurbishment, testing, and decommissioning of combat vehicles and various types of ordnance.

The SIA was placed on the National Priorities List (NPL) on March 13, 1989. On June 13, 1990, a Federal Facility Agreement (FFA) was executed between United States (U.S.) Environmental Protection Agency (EPA) Region 4, Alabama Department of Environmental Management (ADEM), and U.S. Department of the Army. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 Information System (CERCLIS) identification number for the ANAD SIA is AL3210020027. Currently funding for site restoration is provided by the U.S. Army Environmental Command (AEC) under the Defense Environmental Restoration Program (DERP).

The ANAD cleanup strategy includes designation of Operable Units (OUs) targeted for discrete remedial actions. Five OUs have been defined to date: (1) the SIA Groundwater OU (OU-1), (2) the SIA Soil OU (OU-2), (3) the Ammunition Storage Area (ASA) OU (OU-3), (4) the Military Munitions Response Program (OU-4), and (5) the Western Industrial Area (OU-5). OU-1, which is the subject of this Interim Record of Decision (IROD) Amendment, is further divided into four different source areas: Trench, Landfill, Northeast, and Industrial Areas. The environmental process is administered and led by the Army in cooperation with the ANAD Partnering Team. The ANAD Partnering Team includes members of the Army, EPA Region 4, and ADEM, all of which are signatories of the FFA (1990).

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the Amended Interim Remedy for ANAD OU-1, Anniston, Alabama, which was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record for the site.

1.3 ASSESSMENT OF SITE

The response action selected in this IROD Amendment is necessary to protect the public health and welfare, and the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment. A CERCLA action is required because contaminated groundwater is present at the site that poses an unacceptable risk to human health.

1.4 PREVIOUS ATTEMPTED IROD AMENDMENTS

The original IROD for the "Groundwater Operable Unit" at the SIA was signed on October 26, 1991 (Anniston Army Depot, 1991). This IROD documented the selection of an interim remedial action for the on-post shallow groundwater component. This interim remedial action included the removal and treatment of contaminated shallow groundwater, treatment of the groundwater for volatile organics by air stripping and activated granular carbon filtration. This system is referred to as the Groundwater Interceptor System (GWIS).

The Army determined that the GWIS was not as effective as intended and that the Army would upgrade the GWIS. The Army upgraded the system because the original system experienced frequent fouling due to iron bacteria, which limited the effectiveness of the ex-situ groundwater treatment component of the Interim Remedy. Also changes to the chemical of concern (COC) list based on the results of the 1998 and 2008 Human Health Risk Assessment (HHRA) was to be documented in an IROD Amendment. The first attempted IROD Amendment was to include the changes for the COC list from the 1998 HHRA and GWIS upgrades. The original time frame for completing this IROD Amendment was 2001/2002; however, the planned IROD Amendment was never completed.

The 1991 IROD established the on- and off-post groundwater units. The on-post groundwater component included shallow groundwater in the residuum and upper several feet of bedrock within the boundaries of the SIA. The definition of off-post groundwater is a misnomer because it not only includes shallow and deep groundwater beyond the physical boundaries of the SIA, but also includes deeper groundwater beneath the SIA. In 2004, the on-post and off-post designations were replaced by the term combined groundwater (CGW), which includes both on- and off-post groundwater of all depths. The CGW is referred to as OU-1. In late 2007/early 2008, there was another effort to finalize the IROD Amendment to reflect the upgraded status of the GWIS and the change in the unit's designation, but this document was also not completed.

In 2010, as the Focused Feasibility Study (FFS) for the OU-1 was initiated as it was evident that the GWIS system was not performing as intended. The GWIS performance was documented in 5 year reviews (U.S. Army Corps of Engineers, 2010) and several technical memoranda (Tetra Tech, 2012b). It was evident that an upgraded groundwater remedial strategy and plan would be required. The site overall strategy was documented in a Strategic Plan for OU-1 (Tetra Tech, 2011). It was subsequently decided that an upgraded remedial system would be evaluated in the FFS but it would not result in a final Record of Decision (ROD), but in the continuation of the IROD. In April 2012, the FFS was finalized and an amendment to the IROD was proposed to the public in the Proposed Plan for OU-1 (Tetra Tech, 2012d).

1.5 CONDITIONS THAT LED TO THE INTERIM RECORD OF DECISION AMENDMENT

An amendment to the Interim Remedy is needed since the current Interim Remedy is not protective. According the 2010 5-year review, "The interim remedy at OU-1 is not protective for the following reasons. The onsite groundwater treatment system at OU-1 is operating properly but is not significantly reducing the extent or mobility of contamination in the groundwater. High contaminant levels remain onsite and low levels of contaminants continue to migrate offsite (USACE, 2010)."

It was anticipated that completion of the FFS would lead to a final ROD. However, because of the complexities of the site, including complex site geology and hydrogeology, potential of residual dense non-aqueous phase liquid (DNAPL) in the subsurface, high contaminant mass estimates, high uncertainty in the mass estimates, and long estimated cleanup time frames (potentially up to thousands of years), along with the inclusion of the aggressive near-term bioremediation for the Landfill, Trench and Northeast Areas for a finite period (5-years), the Army, EPA, and ADEM agreed to an IROD Amendment prior to a final ROD for OU-1.

Originally, the Anniston Tier 1 Partnering Team (Army, EPA, and ADEM) agreed in 2011 to limit the duration of the partial source mass removal to 5 years. Moreover, the Tier 1 Partnering Team agreed that the impact of the partial source mass removal will take hundreds or thousands of years to have a measurable change on concentrations in Coldwater Spring (CWS) based upon predictive modeling (Appendix A). At this time, it is not clear how many years (e.g. hundreds or thousands of years) will be required to observe change in CWS based upon the significant unknowns in the hydrogeological relationship between the contamination in the source areas and CWS, which impacts certainty in the modeling (Tetra Tech, 2011 and 2012b). Subsequent to this Tier 1 agreement, EPA's Remedial Decision Team (RDT)[1] and ADEM Tier 2 and Tier 3 overturned this decision. However, the parties have compromised and will now require the partial source mass removal be operated until a measurable impact on CWS is observed, because a measurable impact rather than an arbitrary time-frame should trigger the next decision; however, the parties have also agreed that a performance evaluation will be conducted every 5 years and that partial source mass removal could be terminated without a measurable impact, if the parties agree and data analysis supports termination. While the termination is not based on an arbitrary timeframe, routine analysis to continue remediation is and the partial source mass removal will be operated until the impact on CWS is determined. Explanation and criteria for the operation and termination criteria of the Amended Interim Remedy is outlined in Section 2.13.

Following 5 years of remediation and monitoring per this IROD Amendment, the Tier I Partnering Team will reconvene to discuss more permanent remedial options, including the potential to implement a final ROD.

1.6 DESCRIPTION OF AMENDED INTERIM REMEDY

This IROD amendment documents the Amended Interim Remedy for OU-1. The major components of the Amended Interim Remedy for OU-1 include:

- Point of Use Treatment (POUT) at CWS [Krebs Water Treatment Plant (KWTP)].
- An enhancement to the current GWIS, including significant modifications to the current extraction well network and the treatment process.
- Long-term monitoring (LTM) of groundwater (both on-post and off-post wells (including private wells)).
- Implementation of Land Use Controls (LUCs).
- Aggressive near-term bioremediation or partial source mass removal for the Landfill, Trench, Northeast, and Industrial Areas (Aggressive bioremediation will not be conducted in the Industrial Area due to significant implementability and access limitations. However, if operations in the Industrial Area change and if access can be obtained, aggressive near-term bioremediation will be implemented, as necessary).
- Lifecycle optimization of the remedial system to ensure remedial performance.
- Five-year performance reviews to ensure protectiveness of the remedy.

It is intended that the Amended Interim Remedy will achieve risk reduction, provide protection under the current and reasonably anticipated future non-residential use at ANAD, and protect the regional drinking water source. Risk associated with exposure to contaminated groundwater will be mitigated via remedial measures and LUCs. The enhanced Groundwater Interceptor System (eGWIS) and aggressive near-term bioremediation will address the contamination within on-site source areas. The POUT at KWTP will protect the regional drinking water source. Long-term monitoring will be performed to monitor groundwater concentrations on and off-site, so that off-site migration is minimized. With the exception of the risks associated with the Pygmy Sculpin in CWS which is currently being evaluated (Section 2.7.2), pathways to human health and the environment via surface water are within acceptable limits in CWS.

[1] The RDT is an independent team within the EPA that evaluates remedies and provides recommendations to the EPA Branch Chiefs of the technical validity of a remedy.

This remedy does not include or affect any other sites at the facility. Implementation of this Amended Interim Remedy will allow industrial/commercial use of the site, which is consistent with the current use and the overall cleanup strategy for ANAD. Note that the Community Involvement Plan and Emergency Response Plan also include guidance on CWS.

1.7 STATUTORY DETERMINATIONS

Considering the ongoing evaluation of the Pygmy Sculpin described above and in Section 2.7.2, the Amended Interim Remedy is protective of human health and the environment in the short term and is intended to provide adequate protection until a final ROD is signed that complies with (or waives) those federal and state requirements that are applicable or relevant and appropriate for this limited-scope action. Although this interim action is not cost-effective based upon the uncertainly of restoring the aquifer to drinking water standards within a reasonable time frame (Appendix A), the Army, EPA, and ADEM have agreed that implementing the aforementioned technologies (i.e. all best available technologies) with defined termination criteria is in the best interest of the public. This interim action is not intended to address fully the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action does utilize treatment and thus supports that statutory mandate. Because this action does not constitute the final remedy for OU-1, the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action. Subsequent actions are planned to fully address the threats posed by conditions at OU-1.

Because this interim remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within 5 years after commencement of the remedial action. Because this is an interim action ROD Amendment, review of this site and remedy will be ongoing as the Army continues to develop the final remedy for OU-1.

1.8 DATA CERTIFICATION CHECKLIST

A data certification checklist is provided in Table 1-1. This checklist certifies that the IROD Amendment contains specific remedy selection information. References to page numbers where the information can be found in the body of this document are also indicated. Additional information can be found in the Administrative Record file for ANAD.

Table 1-1. IROD Data Certification Checklist	
Data	**Location in IROD**
Chemicals of concern	Section 2.5
Baseline risk represented by the chemicals of concern	Section 2.7
Cleanup levels established for chemicals of concern and the basis for these levels	Section 2.8
How source materials constituting principal threats are addressed	Section 2.10 and 2.11
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the risk assessment	Section 2.6
Potential land and groundwater uses that will be available at the site as a result of the Amended Interim Remedy	Section 2.6
Estimated capital, operating and maintenance (O&M), and total net present worth (NPW) costs; discount rate; and number of years over which the remedy costs are projected	Section 2.7
Key factors that led to the selection of the remedy	Section 2.12

1.9 AUTHORIZING SIGNATURES

12 June 2015

David D. Halverson
Lieutenant General, U.S. Army
Assistant Chief of Staff for Installation Management

Date

July 22, 2015

Franklin E. Hill
Director
Superfund Division
EPA, Region 4

Date

July 16, 2015

Phillip D. Davis
Chief
Land Division
Alabama Department of Environmental Management

Date

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

This document is issued by the Army, as the lead agency for all investigations and cleanup programs ongoing at ANAD, and EPA, with support from ADEM.

Site Name: ANAD OU-1, CERCLIS AL3210020027

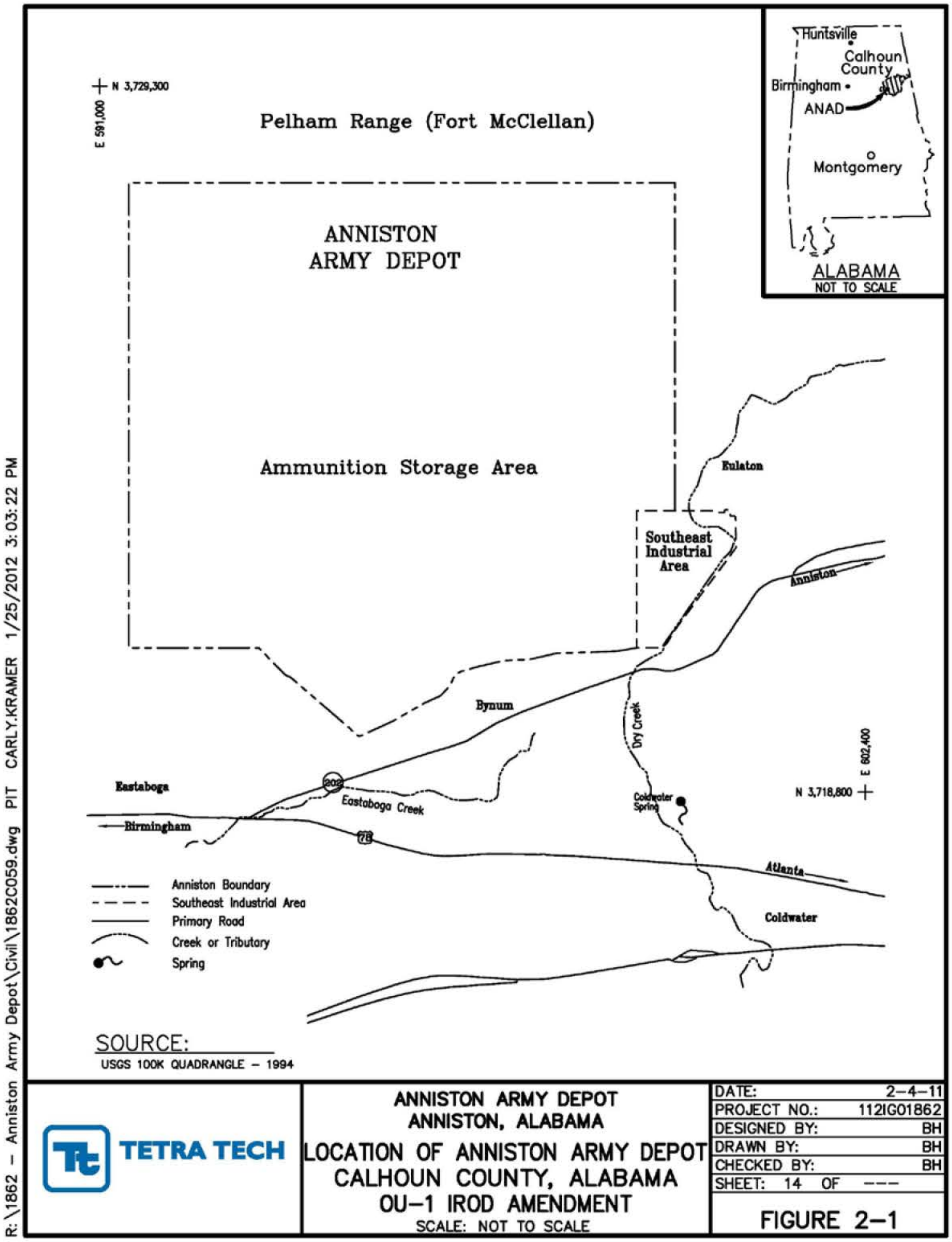
ANAD is an active military facility located in northeastern Alabama about 10 miles west of the City of Anniston (Figure 2-1). ANAD was constructed during 1941 to serve as a munitions storage facility. The mission of ANAD was expanded during World War II to include the resetting, testing, and decommissioning of combat vehicles and various types of ordnance. The present mission of ANAD includes combat vehicle maintenance, small arms repair, and ammunitions storage. ANAD is a Center for Technical Excellence for several families of combat vehicles and is also the Army's designated organic repair facility for the Stryker family of vehicles.

Shallow and deep groundwater underlying the SIA, which comprises only 525 acres of the 15,319 acres at ANAD, is the focus of this IROD Amendment. The original IROD, signed in 1991, addressed only shallow groundwater.

The majority of the SIA, which includes over 50 different buildings that house various activities from heavy industrial operations to administrative offices, has been used for industrial activities since the 1940s and is the primary area at ANAD where combat vehicle and small firearms maintenance occurs. Testing of combat vehicles is conducted on a track in the SIA. Most of the SIA where industrial activities take place is covered by either concrete or asphalt; however, the areas used for vehicle storage are largely unpaved.

The storage, maintenance, and industrial functions of ANAD have resulted in the generation of hazardous wastes. Typical waste-generating processes at ANAD have included vapor degreasing, metal cleaning, sandblasting, electroplating, and painting. The wastes generated from these activities included metals, cyanide, phenols, pesticides, herbicides, chlorinated hydrocarbons, petroleum hydrocarbons, solvents, acids, alkalis, chelating agents, asbestos, and creosote. From the 1940s through the late 1970s, wastes generated at ANAD were disposed of on site in trenches, lagoons, landfills, and other surface impoundments. Trichloroethene (TCE), a solvent and chlorinated hydrocarbon, also known as trichloroethylene, is the most common waste material encountered in the groundwater at OU-1.

The SIA was placed on the National Priorities List in 1989. Currently funding for site restoration is provided by the U.S. Army Environmental Command (AEC) under the Defense Environmental Restoration Program (DERP), and OU-1 cleanup activities are being performed as required by and in accordance with CERCLA.



N 3,729,300
E 591,000
Pelham Range (Fort McClellan)
ANNISTON ARMY DEPOT
Ammunition Storage Area
Southeast Industrial Area
Eulaton
Anniston
Bynum
Dry Creek
E 602,400
N 3,718,800
Eastaboga
Eastaboga Creek
Coldwater Spring
Birmingham
78
202
Atlanta
Coldwater
Anniston Boundary
Southeast Industrial Area
Primary Road
Creek or Tributary
Spring
SOURCE:
USGS 100K QUADRANGLE – 1994
Huntsville
Calhoun County
Birmingham
ANAD
Montgomery
ALABAMA
NOT TO SCALE
R:\1862 – Anniston Army Depot\Civil\1862C059.dwg PIT CARLY.KRAMER 1/25/2012 3:03:22 PM
TETRA TECH
ANNISTON ARMY DEPOT
ANNISTON, ALABAMA
LOCATION OF ANNISTON ARMY DEPOT
CALHOUN COUNTY, ALABAMA
OU–1 IROD AMENDMENT
SCALE: NOT TO SCALE
DATE: 2–4–11
PROJECT NO.: 112IG01862
DESIGNED BY: BH
DRAWN BY: BH
CHECKED BY: BH
SHEET: 14 OF ---

FIGURE 2–1

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

As early as 1976, the Department of Defense (DoD) Installation Restoration Program (IRP) conducted studies to evaluate the extent of contamination at ANAD. Most of the investigations focused on shallow groundwater encountered in the residuum and weathered bedrock beneath the facility. Other studies focused on off-site groundwater. ANAD signed a three-party Federal Facility Agreement (FFA) with EPA and ADEM in June 1990. In September 1991, an IROD for the “Groundwater Operable Unit” for the SIA established the on- and off-post groundwater units at the SIA. Per the original IROD, the boundaries of the on- and off-post groundwater units were defined vertically and horizontally, as follows:

- On-Post Groundwater

  The on-post groundwater component included shallow groundwater in the residuum and upper several feet of bedrock within the boundaries of ANAD. This represents the limits of Phase I and Phase II Remedial Investigation (RI) for the groundwater (approximately 1992 to 1995) (Jacobs 1992, SAIC, 1998a).

- Off-Post Groundwater

  The definition of off-post groundwater, as defined in the IROD, is a misnomer because it not only includes shallow and deep groundwater beyond the physical boundaries of the ANAD but also includes groundwater beneath ANAD property and beneath the vertical limits of the SIA Phase I and Phase II investigations. The off-post groundwater was first investigated during the Phase I off-post RI (SAIC, 2001).

In 2004, the on-post and off-post designations were replaced by the term CGW, which includes both on- and off-post groundwater of all depths. The CGW is referred to as OU-1. The results of the first RI using this designation were reported in the CGW RI Report (SAIC, 2004). The CGW was further investigated and the results were reported in the Comprehensive Groundwater RI Phase III Report (SAIC, 2008a).

In addition to the RIs, a biannual groundwater sampling program, which began in 2002, is ongoing to collect wet season (e.g., March and April) and dry season (e.g., October and November) data. Sampling locations include on- and off-post monitoring wells, springs, and private wells. This sampling was supplemented by monthly sampling of selected locations (on- and off-post) from 2002 through 2004.

A draft Feasibility Study (FS) was prepared in 2006. During the evaluation and refinement of this document, consensus could not be reached among the ANAD Partnering Team members (Army, EPA, and ADEM) on a number of issues including whether the FS fully evaluated all of the remedial options for each of the four source areas, identification of specific technology uncertainties, and unresolved comments and issues on the OU-1 FS. To move the process forward the ANAD Partnering Team agreed to finalize the FS in 2008 and develop a Focused Feasibility Study (FFS). Prior to the development of the FFS, a series of technical memoranda (TMs) were prepared, reviewed and approved by the Partnering Team as the technical foundation for the FFS. The TMs were developed to improve understanding of the site conditions and uncertainties, refine the conceptual site model (CSM), and evaluate potential remediation technology combinations for OU-1. A Strategic Plan was then developed collectively by the ANAD Partnering Team to outline the remedial strategy for OU-1. Based on the TMs and the Strategic Plan, an FFS was developed and finalized in April 2012.

The historical investigations and activities for OU-1 are summarized in Tables 2-1 (Pre-FFA) and 2-2 (post-FFA).

TABLE 2-1

PRE-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Report of Industrial Waste Survey: Anniston Army Depot (USAEHA, 1967)	USAEHA performed the earliest quantitative evaluations of environmental conditions at the Southeast Industrial Area (SIA). This 1966 report assessed industrial wastewater generated at the Anniston Army Depot (ANAD) including wastewater pH, phosphorus, phenols, cyanide, chromium, other heavy metals, oils, and grease as parameters requiring control.
Water Quality Engineering Consultation (USAEHA, 1980)	In 1980, groundwater samples were collected by USAEHA from 22 on-post wells. Groundwater contained low concentrations of TCE. Three wells near the chemical sludge disposal trenches contained methylene chloride.
Anniston Army Depot Resource Conservation and Recovery Act Studies: Final Engineering Report (ESE, 1981)	This report evaluated three of the solid and hazardous waste landfill sites in the SIA in September 1979 to determine the potential for groundwater, surface water, and/or air contamination and to recommend actions to bring the sites into compliance with state and federal regulations.
Geophysical and Geohydrologic Investigations of Anniston Army Depot (Technos, 1981)	A geophysical and geohydrologic study was performed to investigate the depth and configuration of the top of bedrock.
Groundwater Quality Assessment Plan (USATHAMA, 1981)	This investigation determined the extent of hazardous contaminant migration and developed plans for abatement. The study included results from a geophysical evaluation (Technos, 1981) and groundwater sampling at 41 monitoring wells. The study identified the Landfill Area and Trench Area as major sources of contamination.
Groundwater Quality Assessment of the Southeast Area (Battelle, 1982) *Source Identification, Contaminant Transport Simulation, and Remedial Action Analysis* (Battelle, 1984)	These two reports summarize the detailed investigation of past disposal practices, identification of major source areas, characterization of groundwater contamination, and prediction of contaminant transport in groundwater by numerical modeling. The 1982 study determined that VOCs were present in groundwater near Buildings 114 and 130, and that hexavalent chromium was present in the effluent of the Building 114 dewatering system. Battelle installed and sampled 25 groundwater monitoring wells and three large diameter wells. They concluded that groundwater contamination was migrating beyond the ANAD boundary at low concentrations, possibly along suspected high-permeability paleochannels that could potentially serve as conduits to Coldwater Spring. This interpretation was not confirmed by later investigations.

TABLE 2-1

**PRE-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA**

Report Title	Description
Groundwater Monitoring Results for Anniston Army Depot, Anniston, Alabama (USAEHA, 1982)	Wells were installed to monitor groundwater quality around the Industrial Wastewater Treatment Plant (IWTP), the Landfill Area, and the new lagoons. Groundwater monitoring data collected during the 1970s indicated contaminated groundwater associated with the landfills, but not with the IWTP (constructed in 1976) or the lagoons.
Remedial Action of Hazardous Waste Sites: Anniston Army Depot (Weston, 1984)	Approximately 62,000 tons of contaminated wastes and soils were excavated from the Chemical Sludge Waste Pits (SWMU 1), Facility 414 Old Lagoons (SWMU 12), and Building 130 Sump (SWMU 25). The materials were transported off-Site and disposed of in a landfill.
Investigation of Possible Paleochannels at the Anniston Army Depot, Anniston, Alabama (Technos Inc., 1985)	Technos performed a geophysical and geohydrologic study to investigate the potential influence of paleochannels on off-Site contaminant migration. They concluded that paleochannels were not significant features in the subsurface.
Off-Post Investigation at Anniston Army Depot: Summary of Preliminary Results (ESE, 1986)	This investigation was proposed by Battelle. A previous survey found several potential paleochannel locations but the associated installation of 13 off-post groundwater monitoring wells did not confirm the presence of paleochannels (Technos, 1981). ESE collected groundwater samples from 53 on- and off-post wells, the Building 114 dewatering sump and Coldwater Spring. The study concluded that levels of contaminants found in Coldwater Spring and in some off-Site wells did not appear to be directly related to on-Site contamination because the areas of contamination were physically separated by areas of uncontaminated groundwater.
Photogeologic Study of Potential Groundwater Pollution Pathways between Anniston Army Depot and Coldwater Spring, Alabama (Bionetics, 1987)	Bionetics conducted a photogeologic study and concluded that groundwater from ANAD could enter the confined aquifer along the Jacksonville fault and emerge at Coldwater Spring. This was different from the previously accepted conceptual site model (ESE, 1986). Evidence supported the revision. The Shady Dolomite confining layer was far more extensive than previously thought, and the Shady Dolomite was found to contain one fault and multiple fracture traces that could serve as vertical migration pathways for contaminants. The study recommended characterizing the artesian groundwater system and the potential for contaminant migration from ANAD to Coldwater Spring.
RCRA Facility Assessment (NUS, 1987)	The RCRA Facility Assessment was conducted to evaluate the release of hazardous wastes or hazardous substances at ANAD. The report identified 38 SWMUs and described the Site setting, waste characteristics, migration pathways, and evidence of release at each SWMU.

TABLE 2-1

**PRE-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA**

Report Title	Description
Three Sources Ground Water Collection and Treatment System (Weston, 1987)	This report summarizes the conceptual design of the groundwater extraction and treatment systems located in the Landfill Area, Trench Area, and Industrial/Northeast Area (Buildings 130 and 513).
Feasibility Study for Anniston Army Depot, Endangerment Assessment – CATSDR Submittal (ESE, 1988a) *Feasibility Study for Anniston Army Depot, Endangerment Assessment – ATSDR Submittal* (ESE, 1988b)	The Endangerment Assessment evaluated the potential risk to human health and the environment from potential Site releases. Exposure routes via contaminated groundwater, surface water, and air were considered (ESE, 1988a). A supplemental report was prepared to provide additional information required by the Agency for Toxic Substances and Disease Registry. The four exposure pathways determined to be complete were not found to present a significant risk to human health. Additional pathways were suspected to be complete but the exposure potential was found to be low.
Groundwater Extraction Optimization (Jordan, 1989)	Presented recommendations for the design and installation of the GWIS at the Landfill, Trench, and Industrial/Northeast Areas. The GWIS was installed in accordance with these recommendations.

Source: Malcolm Pirnie (2006)

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Groundwater Extraction System Optimization Study (JEG, 1993)	JEG conducted an evaluation of the operation and effectiveness of the Ground Water Interception System. They concluded that the extraction system was not significantly influencing groundwater flow, although it was removing contamination from groundwater. The potential effectiveness of the system was not evaluated due to a lack of data. Seven specific recommendations were made to improve the pump-and-treat system (e.g., cleaning the wells, additional quantitative studies).
Groundwater Tracing Studies (Ewers Water Consultants, 1994)	JEG, in conjunction with Ewers Water Consultants (EWC), conducted a groundwater dye trace study from March 1992 to October 1993. EWC injected dyes into monitoring wells and extraction wells located in the Trench Area, the Landfill Area and the Northeast Area. Dyes injected in the Trench Area were detected outward in a multidirectional pattern (including upgradient), indicating widespread hydrogeologic connection up to 5.5 miles from the injection points. Minimum groundwater velocities ranged from 0.09 to 0.24 miles per day. Dyes injected in the Landfill Area were detected outward in a multidirectional pattern as far as Coldwater Spring, 1.6 miles south of the Site and at springs in the Pelham Range, 6 miles to the northwest. Dyes injected in the Northeast Area were detected very soon after injection inside the SIA - in the bottom of Dry Creek and in a sump near Building 14. The sump is believed to be the location of a former spring. Dry Creek is known to receive discharge from shallow groundwater. These results indicated that the aquifer beneath the Site is dominated by conduit porosity, which is the result of dissolution of the carbonate bedrock along bedding planes, joints, and faults. There is a potential for widespread transport of the SIA groundwater plume.
Draft Final Phase I Remedial Investigation Report (JEG, 1994a)	The Phase 1 on-post RI Report, performed by JEG in 1991 and 1992, addressed the 29 SWMUs within the SIA. Five of the SWMUs were recommended for no further action. Twenty-four SWMUs were recommended for further investigation during the Phase 2 RI.
Draft Final Facility 414 Lagoons (SWMU 12) Supplemental Investigation (JEG, 1994b)	In January 1994, JEG conducted a supplemental investigation at Facility 414 Old Lagoons (SWMU 12) to gather information on the nature and extent of the residual wastes and to estimate the volume of organics-contaminated soil to be excavated as a removal action. Based on observations from 27 geotechnical soil borings, abrasive dust wastes appeared to be widespread. Residual sludge was found in isolated pockets located mostly in the eastern portions of the middle lagoon.

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Pilot Chemical Processing Study for Groundwater Extraction Well System (USACE, 1996)	USACE performed an on-Site pilot project during the summer of 1995 to determine the best solution(s) to fouling problems encountered in the GWIS. They proposed constructing a new central groundwater treatment system and modifying eight of the 16 extraction wellheads. Based on this study, USACE recommended that a new 200-gpm centralized treatment facility be constructed.
Phase II Remedial Investigation, Anniston Army Depot, Southeast Industrial Area (SAIC, 1998a)	Phase II RI activities were performed at several study areas within the SIA. Seventeen SWMUs were recommended for no further action; seven were recommended for further evaluation and/or remediation. This study also assessed the extent of groundwater contamination in the shallow aquifer and identified the potential impacts of DNAPL in source areas. The report notes that DNAPL is present in areas beyond the reach of the GWIS and also notes that the GWIS did not significantly improve groundwater quality in nearby monitoring wells. Hydrogeologic studies performed as part of the Phase 2 RI confirmed that on-Site shallow groundwater was connected to deeper groundwater and contamination could therefore be migrating off-Site via deeper groundwater. Off-Site groundwater sampling, sediment and surface water sampling at Dry Creek, and on-Site groundwater sampling in the Landfill, Industrial, Northeast, and Trench Areas were recommended.
Report of Findings for the Groundwater Tracer Test at the Anniston Army Depot, Southeast Industrial Area (SAIC, 1998b)	In 1997, SAIC and Crawford & Associates (SAIC/C&A) performed a second dye tracing study in the same areas. This study was implemented to resolve the uncertainties associated with the dye migration direction in the first dye tracing study. The specific wells within the Trench, Northeast and Landfill Areas, the type of dye, the injection procedures, and the time of year were different in the second study. More extensive monitoring for background dye concentrations was performed prior to dye injection. SAIC/C&A were therefore better able to interpret low-level dye concentrations detected after injection. Dyes injected by C&A were not detected above background levels outside the SIA, except for one detection 18 months later. Based on these results, SAIC concluded that the shallow aquifer at SIA was not dominated by conduit flow. Note that these results (i.e., not dominated by conduit flow) is contrary to the results (i.e. is dominated by conduit porosity) of the ‘Groundwater Tracing Studies’ performed by Ewers in 1994.

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Final Summary Report, Emergency Groundwater Treatment at SWMU 12 (Harding ESE, 2000)	Three in-situ chemical oxidation treatments were conducted at SWMU 12, including a pilot study in 1996, full-scale treatment of residual sludge and impacted soils in 1997, and treatment of underlying groundwater in 2000. All three treatments injected Fenton's Reagent (iron and hydrogen peroxide).
Independent Technical Review: ANAD Response to Comments (ANAD Partnering Team, 2001)	The Independent Technical Review Committee evaluated available Site data and recommended the following: • Further vadose zone remediation at SWMU 12 should not be performed because it was unlikely to improve the groundwater quality in the presence of DNAPL. • A Technical Impracticability waiver should be considered for groundwater based on the presence of DNAPL in bedrock. • A conceptual site model should be developed. • Groundwater flow along the JFZ, which borders the Site, should be evaluated.
Phase I of the Offpost Remedial Investigation of the Hydrogeologic Characterization of the Jacksonville Thrust Fault (SAIC, 2001d)	This study investigated hydrogeologic conditions along the southern boundary of the Anniston Army Depot (ANAD) and assessed the role of the JFZ in controlling groundwater movement and contaminant migration in the bedrock. Rock coring and geophysical testing was performed at 11 locations in three traverses across the fault zone. The JFZ was found to be highly permeable and a preferential, although not a controlling, pathway in the rock. This may be reflected in the lower potentiometric surface along the fault zone. Deep groundwater flow is primarily controlled by a southwestward gradient toward Coldwater Spring. The study also concluded that pumping at the Cooper Well near the SIA boundary may capture Site contaminants.

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Combined Groundwater Remedial Investigation (SAIC, 2004)	SAIC prepared a Combined Groundwater RI Report in 2004. This investigation focused on a comprehensive evaluation of deep and shallow groundwater. The study confirmed the presence of VOC contamination in the deep bedrock and confirmed that higher TCE concentrations were present at the interface of the residuum and weathered bedrock. The discrete nature of groundwater flow zones in the deep bedrock and limitations to finding specific contaminant-bearing pathways were described. A conceptual basis for the presence of free-phase DNAPLs as secondary sources of contamination was described in both deep and shallow groundwater. The areas that likely contained DNAPL were identified. Hydrogeologic conditions and VOC distribution to a depth of 700 feet were investigated in the JFZ.
Draft Technical Impracticability Evaluation (Malcolm Pirnie, 2006)	This document evaluates the technical feasibility of groundwater remediation within portions of the SIA and provides information about whether groundwater restoration to ARARs is technically impracticable from an engineering perspective within a reasonable timeframe (approximately 100 years). The document concludes that the presence of DNAPL in the complex hydrogeologic settings makes site restoration technically impracticable to achieve ARARs within 100 years in site source areas. Options for designation of TI zones are suggested in the document.
Comprehensive Groundwater Remedial Investigation Extended Data Summary Report for 2003, Southeast Industrial Area at Anniston Army Depot, Anniston, Alabama (SAIC 2005a)	Report summarizes groundwater chemistry data for sampling events completed during calendar year 2003 at ANAD. The sampling was performed as an element of an extended effort to monitor groundwater contaminant trends for the SIA remedial investigation. Groundwater sampling was completed during a wet season period and dry season period consistent with previous groundwater sampling events.
Comprehensive Groundwater Remedial Investigation Extended Data Summary Report for 2004, Southeast Industrial Area at Anniston Army Depot, Anniston, Alabama (SAIC 2005b)	Report provides groundwater results for two site-wide groundwater sampling events and a single sampling of private wells completed during 2004. The site-wide groundwater sampling events were completed during the dry season and wet seasons. Sample locations include wells and springs both within the ANAD boundary and off-site.

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	**Description**
Data Summary Report for 2005, Coldwater Spring and Private Well Sampling Events, Anniston Army Depot (SAIC 2007a)	Report provides groundwater results analytical results, in a summary format, for groundwater samples collected each month from three locations at Coldwater Spring and from select water supply wells located at private residences.
Coldwater Spring Sampling Summary Report for 2006, Anniston Army Depot, Anniston, Alabama (SAIC 2007b)	Report summarizes groundwater chemistry data for samples collected monthly at Coldwater Spring during the calendar year 2006. The sampling of Coldwater Spring on a monthly schedule is being performed as a component of a SIA baseline sampling program and as a best management practice to monitor for contaminants in the spring, which is the drinking water source for the City of Anniston.
Baseline Sampling Data Summary for 2005–2006, Southeast Industrial Area at Anniston Army Depot, Anniston, Alabama (SAIC 2007c)	This report summarizes groundwater chemistry data for baseline sampling events completed during the calendar year 2005 and the wet season (April) of 2006 at ANA). The sampling was performed as an element of an extended effort to monitor groundwater contaminant trends for the SIA RI. For 2005, groundwater sampling was completed during both a wet-season period and dry-season period, consistent with previous groundwater sampling events. For 2006, only the results of a wet-season sampling event are included. This report also provides the results of the measurement of groundwater levels in monitoring wells collected manually during manual seasonal measurements.
Operable Unit 1Groundwater Sampling Data Summary for 2006–2007, Southeast Industrial Area at Anniston Army Depot, Anniston, Alabama (SAIC 2008a)	Report provides analytical groundwater sampling results in a summary format, for three site-wide groundwater sampling events completed during 2007 and a portion of 2006.. Sample locations include wells both within the ANAD boundary and off-site. Additionally, samples were analyzed for a set of natural attenuation parameters to assess whether the geochemical and biological conditions of the SIA aquifer are conducive to biodegradation of the organic COCs.

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	**Description**
Comprehensive Groundwater Remedial Investigation, Phase III (SAIC, 2008b)	This report integrated the results of previous studies with the results from six rounds of seasonal groundwater sampling, background well data, and additional shallow on-Site well data. The major contributions of this RI include the following: • Plume development and migration in the Industrial Area and Landfill Area were described. The groundwater plume is affected by the significant presence of DNAPL in source areas and by natural attenuation processes downgradient of the source areas. • The distribution of dissolved metals exceeding regulatory levels was evaluated. • Source areas that contribute to off-Site contaminant plumes were identified. • Seasonal variations in contaminant concentrations were evaluated. • Published hydrogeologic information and the available sampling results for Coldwater Spring were summarized. • A health risk assessment was performed to evaluate risks of exposure to groundwater on-post, groundwater off-post, and inhalation of soil vapors on-post.
Comprehensive Groundwater Feasibility Study (SAIC, 2008c)	The FS report is for groundwater in and around the SIA, which is defined as OU1 in the FFA for ANAD. This report uses information from all previous studies to evaluate remedies appropriate for the SIA groundwater contamination. The FS addresses both the shallow and deep components of the aquifer, on-site and off-site and includes assessment of the effectiveness of current and past remedial actions, including the groundwater treatment system, as part of the process for developing the final remedy for OU1. In this FS, six final remedial alternatives were selected and evaluated in detail using the nine CERCLA evaluation criteria. The final 6 alternatives are: 1. No action 2. MNA and LUCs 3. Enhanced anaerobic bioremediation, MNA, and LUCs 4. Pump-and-treat, MNA, and LUCs 5. Electrical resistance heating, MNA, and LUCs 6. Permeable reactive barrier, MNA, and LUCs SAIC concludes that Alternative 1 does not achieve remedial action objectives, and Alternatives 2 through 6 present significant technical and programmatic challenges that must be better understood and resolved prior to remedy selection.

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Coldwater Spring Sampling Summary Report for 2008, Anniston Army Depot, Anniston, Alabama (SAIC 2010a)	This report summarizes groundwater chemistry data for samples collected monthly at Coldwater Spring and the Cooper property well during the calendar year 2008. The sampling of Coldwater Spring and the Cooper well on a monthly schedule is being performed as a component of the SIA groundwater monitoring program and as a best management practice to monitor for contaminants in the spring, which is the drinking water source for the city of Anniston and surrounding communities.
Operable Unit-1 Groundwater Sampling Data Summary for Calendar Year 2008, Southeast Industrial Area at Anniston Army Depot, Anniston, Alabama (SAIC 2010b)	This report summarizes groundwater chemistry data for sampling events completed during 2008 at the ANAD. The sampling was performed as an element of an extended effort to monitor contaminant trends in the SIA groundwater of ANAD. This report also provides the results of the measurement of groundwater levels in monitoring wells collected manually during the seasonal sampling events. In addition, an interpretation of MNA parameters is provided along with the results of an optimization approach for the SIA monitoring well network.
Technical Memoranda No. 1 through No. 8 (Tetra Tech, 2010)	Eight technical memoranda (TM) were prepared to increase the understanding of the site conditions, the site conceptual model, and facilitate the development of the Focused Feasibility Study (FFS) (Tetra Tech, 2012). The eight TMs address the following areas for the FFS for Operable Unit 1 (OU1): • TM1: Development of a Quantitative Vertical Mass Flux metric • TM2: Mass Reduction Estimates for Active Treatment Technologies • TM3: Conceptual Site Model, Treatment Trains, and Uncertainties • TM4: Modeling and Analytical Parameters for Analyses and Modeling Assumptions • TM5: Monitored Natural Attenuation Modeling and Parameters • TM6: Pump and Treat System Evaluation • TM7: Cooper's Well Evaluation to Determine Impact on Plume Migration • TM8: Cumulative Impact of Flux from Each Source Area The eight TMs were used to support the development of the Remedial Action Objectives and Exit Strategic Plan (Tetra Tech, 2011) and the FFS.

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Operable Unit-1 Groundwater Sampling Data Summary for 2009, Southeast Industrial Area at Anniston Army Depot, Anniston, Alabama (SAIC 2011)	This report summarizes groundwater chemistry data for sampling events completed during 2009 at the ANAD. The sampling was performed as an element of an extended effort to monitor contaminant trends in the SIA groundwater of ANAD. This report also provides the results of the measurement of groundwater levels in monitoring wells collected manually during the seasonal sampling events. In addition, an interpretation of MNA parameters is provided along with the results of an optimization approach for the SIA monitoring well network.
Remedial Action Objectives and Exit Strategic Plan (Strategic Plan) (Tetra Tech, 2011)	This Strategic Plan outlines the remedial action objectives (RAO) resulting from the completed eight Technical Memoranda and the Tier I Partnering Team (Team) Meetings. It also presents the details and explanation for the decision basis of the FFS Report. As a result, this document serves as the Southeast Industrial Area (SIA) Strategic Plan that will be carried forth from the FFS into the Proposed Plan (PP), Record of Decision (ROD), and ultimately the Remedial Design (RD) and Remedial Action (RA).
Coldwater Spring Sampling Summary Report for 2010, Anniston Army Depot, Anniston, Alabama (SAIC 2012a)	This report provides analytical results, in a summary format, for groundwater samples collected monthly during 2010 from three locations at Coldwater Spring, the former Cooper property well, and twice annually at two surface water locations on the former Cooper property. The sampling is a continuation of previous monthly and annual sampling events to monitor COC concentrations in groundwater sourced from the SIA and present at off-site sample points.
Operable Unit-1 Groundwater Sampling Data Summary for 2010, Southeast Industrial Area at Anniston Army Depot, Anniston, Alabama (SAIC 2012b)	Report summarizes groundwater chemistry data for sampling events completed during 2010 at ANAD. The sampling was performed as an element of an extended effort to monitor contaminant trends in the SIA groundwater of ANAD. This report also provides the results of the measurement of groundwater levels in monitoring wells collected manually during the seasonal sampling events. In addition, a summary of MNA parameter measurements is provided.

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Focused Feasibility Study for Southeast Industrial Area (Operable Unit 1) (Tetra Tech, 2012a)	This FFS report was prepared with the intent to refine the remedial alternatives for the restoration of groundwater in OU 1 of the ANAD. This FFS refines the conceptual site model (CSM), RAOs, and Applicable or Relevant and Appropriate Requirements (ARARs); evaluates remedial technologies/alternatives, and proposes remedial alternatives for OU 1. Remedial alternatives were proposed for each of the source areas of the SIA as follows: <u>Landfill Area:</u> Alternative 1: No Action Alternative 2: Point of Use Treatment (POUT) at Coldwater Spring (CWS), enhanced Groundwater Interception System (eGWIS), long term monitoring (LTM), and Land Use Controls (LUCs) Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs <u>Trench Area:</u> Alternative 1: No Action Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs <u>Northeast Area:</u> Alternative 1: No Action Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs <u>Industrial Area</u>: Alternative 1: No Action Alternative 2 : POUT at CWS, eGWIS, LTM, and LUCs Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs (note: Aggressive Bioremediation will not be conducted in the Industrial Area due to significant implementability and access limitations. However, if operations in the Industrial Area change and access can be obtained, aggressive near-term bioremediation will be implemented, as necessary)

TABLE 2-2

POST-FEDERAL FACILITY AGREEMENT INVESTIGATIONS AND STUDIES
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Report Title	Description
Chemicals of Concern (COCs) Refinement Technical Memorandum for Southeast Industrial Area (Operable Unit 1) (Tetra Tech, 2012a)	The ANAD Partnering Team decided to refine COC retained during the Remedial Investigation (RI) (SAIC), 2008a. COC list by 1) conducting a new background study for metals using site-wide monitoring data, and 2) re-evaluating the Human Health Risk Assessment (HHRA) using more recent monitoring data and the updated background criteria. Based on the results of the new background study and the HHRA re-evaluation, five of the previously retained chemicals were recommended to be removed from the COC list, including beryllium, carbon tetrachloride, aluminum, iron, and chloroform. The recommended new COC list including the following seven chemicals was approved in 2012: TCE, arsenic, chromium, lead, manganese, BEHP, and methylene chloride.
Coldwater Spring Sampling Summary Report for 2011, Anniston Army Depot, Anniston, Alabama (SAIC 2013a)	This report provides analytical results, in a summary format, for groundwater samples collected monthly during 2011 from three locations at Coldwater Spring, the former Cooper property well, and twice annually at two surface water locations on the former Cooper property. The sampling is a continuation of previous monthly and annual sampling events to monitor COC concentrations in groundwater sourced from the SIA and present at off-site sample points.
Operable Unit-1 Groundwater Sampling Data Summary for 2011, Southeast Industrial Area at Anniston Army Depot, Anniston, Alabama (SAIC 2013b)	Report summarizes groundwater and surface water chemistry data for sampling events completed during 2011 at ANAD. The sampling was performed as an element of an extended effort to monitor contaminant trends in the SIA groundwater of ANAD. For 2011, groundwater and surface water sampling was completed during both a wet season period and dry season period, consistent with previous sampling events performed since 2002. This report also provides the results of the measurement of groundwater levels in monitoring wells collected manually during the seasonal sampling events. In addition, a summary of MNA parameter measurements is provided.

2.3 COMMUNITY PARTICIPATION

The Army performs public participation activities in accordance with CERCLA and the NCP throughout the site cleanup process at ANAD, including establishment of Administrative Record (40 CFR 300.800(a)) at the Anniston Public Library, Jacksonville State University Library, and upon request at the ANAD Directorate of Risk Management office, for dissemination of information to the community. The ANAD public record includes the required Administrative Record and a larger collection of documents, the Information Repository, which can be accessed at:

Anniston Public Library
108 East 10th Street
Anniston, Alabama 36201
(256) 237-8501

Jacksonville State University Library (electronic copies only)
700 Pelham Road
Jacksonville, Alabama 36265
(256) 782-5758

Directorate of Risk Management Office (by request)
Bldg 199
7 Frankford Ave.
Anniston, AL 36201-4199
(256) 235-4854

Documents and other relevant information relied on in the remedy selection process are available for public review at the Information Repositories, which include copies of the Administrative Record. For additional information about the IRP at ANAD, contact Dilip Kothari, IRP Manager at (256) 235-4854.

In accordance with Sections 113 and 117 of CERCLA and the NCP (40 CFR 300.430(f)(3)(i)(A)-(F), the Army provided a public comment period from October 15 to November 15, 2012, for the proposed amended interim remedial action described in the Proposed Plan for OU-1. A public meeting to present the Proposed Plan was held on October 23, 2012, at the Marriot Courtyard in Oxford, Alabama. Public notice of the meeting and availability of documents were published in the Anniston Star Newspaper prior to the public meeting. The responses to the comments received during this period are included in the Responsiveness Summary of this IROD Amendment (Section 3.0).

2.4 SCOPE AND ROLE OF OPERABLE UNIT

OU-1 is part of a comprehensive environmental investigation and cleanup program currently being performed at ANAD under CERCLA and is the focus of the IROD Amendment. The following five IRP sites (OUs) have been identified at ANAD:

- **OU-1:** SIA groundwater;
- **OU-2:** SIA soils;
- **OU-3:** ASA (all media);
- **OU-4:** Military Munitions Response Program; and,
- **OU-5:** Western Industrial Area (all media).

OU-2 and OU-3 currently have RODs in place, and LTM is being conducted. OU-4 is in the RI phase, and OU-5, which has the preliminary assessment completed, will proceed to the RI phase in 2013. This IROD Amendment applies only to OU-1.

Investigations at OU-1 indicated the presence of contamination that pose unacceptable human health risk to receptors with exposure to groundwater. Implementation of this amended interim remedy will allow industrial/commercial use of the site, which is consistent with current and reasonably anticipated future use and the overall cleanup strategy for ANAD. The remedy documented in this IROD Amendment will help achieve the Remedial Action Objectives (RAOs) for OU-1, as listed in Section 2.8, except the Cleanup Levels for contaminants listed in Table 2-6 will not be met due to the interim nature of this remedy.

2.5 SITE CHARACTERISTICS

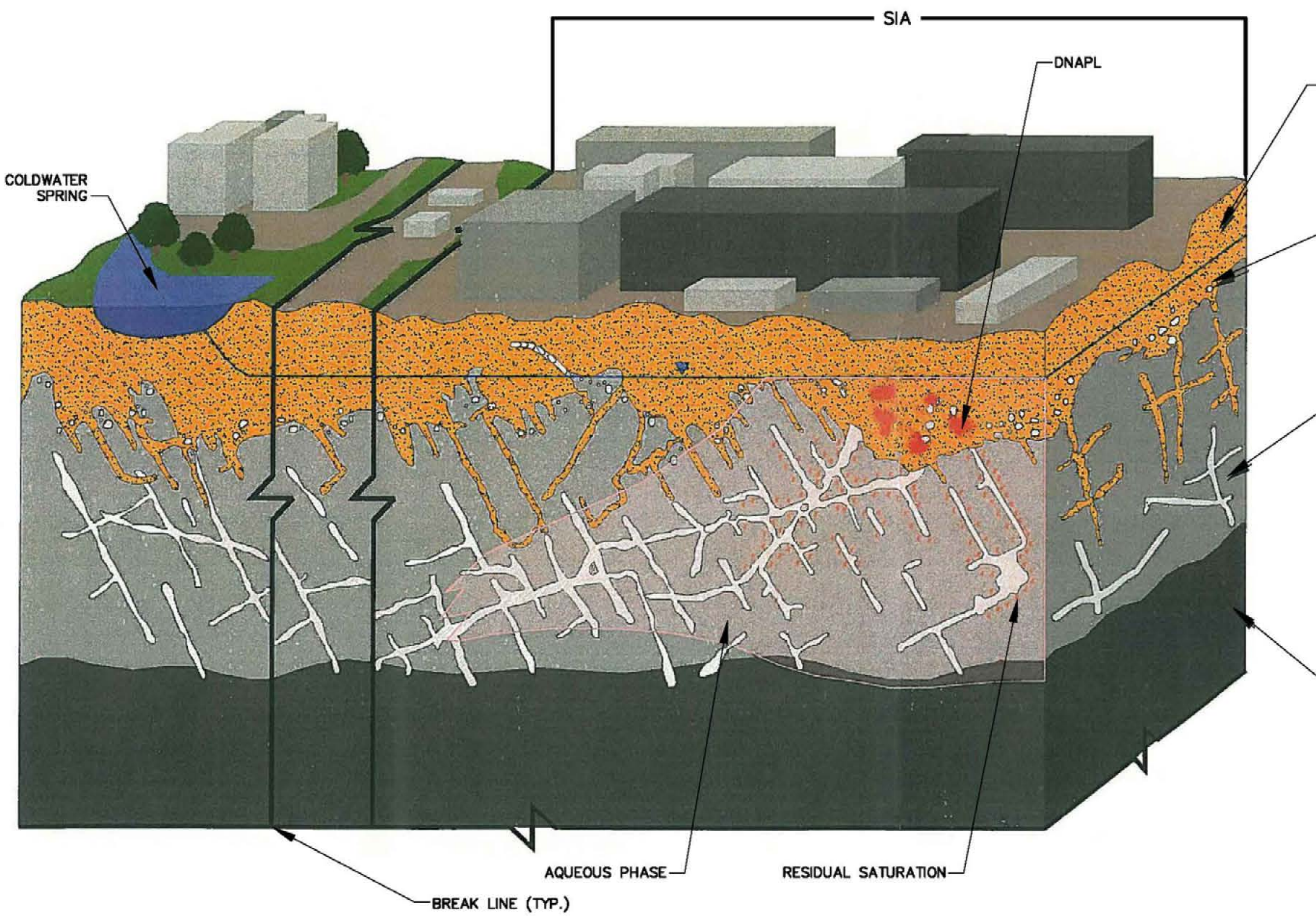
The SIA comprises 525 acres of the 15,319-acre ANAD and is located at the southeastern corner of the installation (Figure 2-1). Site characteristics, including physical characteristics and the natural and extent of contamination, are summarized in this section based on the results of the site investigations summarized in Tables 2-1 and 2-2.

2.5.1 Physical Characteristics

ANAD lies within the northeast-to-southwest-trending Coosa Valley, and the surrounding area consists of flat to gently rolling terrain. The SIA is drained by several small unnamed tributaries that flow into Dry Creek, the major drainage feature of the SIA. Dry Creek originates north of the installation and flows south to the SIA, along its eastern edge, and past CWS to Choccolocco Creek (Figure 2-1).

The geologic characteristics of the ANAD area are very complex. The ANAD area is part of the Appalachian Valley and Ridge physiographic province. The Jacksonville Fault Zone (JFZ) is adjacent to the southeastern boundary of the SIA and underlies the Dry Creek Valley, an area of highly fractured bedrock. Rock formations in this region were repeatedly folded and thrust-faulted creating large-scale, complex, geomorphic and geologic structures oriented in a northeast-to-southwest direction. The thrust-faulting resulted in the stacking and overriding of thick layers of rock within thrust sheets. The tectonic history of the area inverted the original depositional sequence of the strata, moving older rocks on top of younger ones.

The groundwater flow system is very complex as a result of the complex geologic structures. Three hydrostratigraphic units (HSUs) with distinct groundwater flow characteristics have been recognized in the subsurface of the SIA (Figure 2-2). From top to bottom, the three HSUs are (1) an unconsolidated clay-dominated residuum unit; (2) a fractured weathered bedrock unit that is rock-dominated with open and clay-filled cavities; and (3) a fractured unweathered bedrock unit with increased rock competency. The residuum unit generally transitions gradually into the weathered bedrock unit through a Transition Zone, which consists of unconsolidated clayey chert rubble or weathered rock fragments and is typically 2 to 3 feet thick. The transition zone is considered to be part of the weathered bedrock unit. Groundwater flow is in the residuum predominantly vertical through fractures and fissures, and flow is generally horizontal in the Transition Zone and bedrock units; however, downward vertical gradients were found in all three HSUs. The majority of shallow groundwater flow in the SIA occurs in the Transition Zone. Groundwater flow in the vicinity of ANAD is toward the south, with eastern and western components. CWS, the primary source of drinking water for the City of Anniston, ANAD, and several smaller cities, is approximately 1.6 miles south of the SIA.



RESIDUUM INTERVAL

- RESIDUUM INTERVAL IS CLAY-DOMINATED WITH RELIC CHERT BEDDING PLANES, MACROPORES, AND MICROFRACTURES. TOTAL POROSITY IS HIGH BUT EFFECTIVE POROSITY AND PERMEABILITY ARE LOW.
- MEDIAN THICKNESS OF INTERVAL IS 47 FT WITH APPROXIMATELY ½ SATURATED, AS AVERAGE WATER TABLE DEOTH IS 21 FT BGS. LATERAL CONTINUITY OF THIS INTERVAL TO OFFSITE AREAS IS SUSPECT, AS RESIDUUM DEVELOPMENT IS MORE SAPROLITIC IN OTHER FORMATIONS (E.G., ROME FORMATION).
- DNAPL IMGRATION FROM SOURCE AREAS WAS DOWNWARD ALONG RELICT BEDDING PLANES, MICROFRACTURES, AND LOCALIZED PERMEABLE INTERVALS.
- DEPENDING UPON THE ASSUMED CALCULATION PARAMETERS, TCE MASS IN THIS INTERVAL RANGES FROM 160,000 TO 2 MILLION GALLONS, WITH DNAPL AS THE DOMINANT PHASE

TRANSITION ZONE

- THE TRANSITION ZONE IS A GRADATIONAL CHANGING ZONE BETWEEN A CLAY-DOMINATED INTERVAL TO A ROCK-DOMINATED INTERVAL WITH FRATURES AND CLAY INFILLING VOIDS. DEPTH TO TOP OF WEATHERED ROCK RANGES FROM <20 FT TO >200 FT BGS

WEATHERED BEDROCK INTERVAL

- WEATHERED BEDROCK INTERVAL IS ROCK-DOMINATED WITH CAVITIES IN THE ROCK, SMOOTH ROCK FRAGMENTS, AND ENLARGED FRACTURES.
- GROUNDWATER MOVEMENT IS CONTROLLED BY OPEN VOIDS AND FRACTURES IN ROCK. ROCK BLOCKS ARE FRACTURED WITH LOW MATRIX POROSITY DUE TO DIAGENETIC ALTERATION.
- HYDRAULIC CONDUCTIVITY IN THIS ZONE IS CONSIDERABLY HIGHER THAN THE RESIDUUM INTERVAL, AND IS COMPARABLE TO THE UNWEATHERED BEDROCK. GROUNDWATER FLOW IS ACTIVE IN THIS INTERVAL.
- DNAPL MOVEMENT WAS INTO VOIDS AND FRACTURES ONCE POOL HEIGHT CREATED SUFFICIENT PRESSURE TO OVERCOME ENTRY PRESSURE. MATRIX DIFFUSION OF TCE OCCURRED IN THIS INTERVAL FOLLOWING MIGRATION. MOVEMENT AND DISTRIBUTION OF DNAPL INTO ROCK CONTROLLED BY ORIENTATION AND INTERCONNECTION OF FRACTURES. VERTICAL MIGRATION AIDED BY HIGH ANGLE FRACTURES.
- DEPENDING UPON THE ASSUMED CALCULATION PARAMETERS, TCE MASS IN THIS INTERVAL RANGES FROM 18,000 TO 287,000 GALLONS, WITH DNAPL AS THE DOMINANT PHASE.

UNWEATHERED BEDROCK INTERVAL

- UNWEATHERED BEDROCK ZONE IS INTERVAL OF MORE COMPETENT ROCK AS DEGREE OF WEATHERING DIMINISHES. DRILLING RESPONSE WAS NOTED AS BOTH ABRUPT AND GRADATIONAL IN SIA BOREHOLES PENETRATING THIS INTERVAL.
- ROCK IS DENSE TO HIGHLY FRACTURED, WITH FRACTURES RANGING FROM HEALED TO OPEN, WITH INTERVENING ROCK BLOCKS LOW IN MATRIX POROSITY (~5%).
- FLOW ZONES ARE DISCRETE AND PREFERENTIAL, AS INDICATED BY HYDROPHYSICAL TESTING. DOWNWARD GRADIENT IS EVIDENT IN THE SIA, WITH OBSERVED LOCALIZED UPWARD GRADIENTS.
- HIGH CONCENTRATIONS OF VOCS ARE MEASURED IN GROUNDWATER SAMPLED FROM UNWEATHERED BEDROCK WELLS LOCATED NEAR SOURCE AREAS, INDICATING DISSOLVED PHASE PLUMES ARE PRESENT.
- DEPENDING UPON THE ASSUMED CALCULATION PARAMETERS, TCE MASS IN THIS INTERVAL IS ESTIMATED AT 430 GALLONS, ALTHOUGH THIS ASSUMES NO DNAPL IS PRESENT. THE GREATEST UNCERTAINTY IN THE MASS ESTIMATE IS THE POTENTIAL FOR THE PRESENCE OF DNAPL IN THE UNWEATHERED BEDROCK INTERVAL.

NOT TO SCALE

- MAJORITY OF CONTAMINANT MASS IS HELD IN THE RESIDUUM WITH LOW GROUNDWATER FLOW (EXCEPT FOR THE TRENCH AREA); HOWEVER, THOUSANDS OF POUNDS OF MASS STILL RESIDE IN THE WEATHERED BEDROCK IN EACH SOURCE AREA
- MAJORITY OF MASS DISCHARGE IS FROM THE WEATHERED BEDROCK DUE TO HIGHER GROUNDWATER FLOW

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ANNISTON ARMY DEPOT
ANNISTON, ALABAMA

CONCEPTUAL SITE MODEL
OU1 IROD AMENDMENT
SCALE: NOT TO SCALE

DATE:	5/9/11
PROJECT NO.:	112IG01862
DESIGNED BY:	
DRAWN BY:	CK
CHECKED BY:	
SHEET: 5 OF 5	

FIGURE 2-2

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2.5.2 Nature and Extent of Contamination

In accordance with EPA Region 4 guidance "*Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment Bulletins*" (2000a), COCs were identified for OU-1 during the Phase III RI based on HHRA results and Applicable or Relevant and Appropriate Requirements (ARARs) (SAIC, 2008a). ARARs include any federal or state standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate to the site or remedial action. The standards that have been determined to be applicable, relevant and appropriate or a "To Be Considered" (together informally called ARARs) for this action are presented in Table 2-3. All of the ARARs identified by the ADEM have not been included in Table 2-3, because the Army and EPA disagree with the ADEM's recommended ARARs. Until a final Record of Decision (ROD) is issued, ANAD will re-evaluate the ARARs as necessary, for example, during the remediation design and construction phases and during statutorily required 5 Year Reviews.

The 12 OU-1 groundwater COCs identified during the Phase III RI were aluminum, arsenic, beryllium, chromium, iron, lead, manganese, bis(2-ethylhexyl)phthalate (BEHP), carbon tetrachloride, chloroform, methylene chloride, and TCE (SAIC, 2008a). A Technical Memorandum was prepared and approved in 2012 to refine the Phase III RI COC list based on concerns about the quality of the background data set used to determine the original COCs and the need of using more recent monitoring data for the HHRA (Tetra Tech, 2012a). The refined COC list includes the following eight chemicals: TCE, BEHP, methylene chloride, tetrachloroethene (PCE), arsenic, chromium, lead, and manganese.

TCE is the primary OU-1 COC. TCE contamination was found at all four source areas of the SIA: Northeast Area, Industrial Area, Trench Area, and Landfill Area. Therefore, TCE is the best indicator of the overall extent of organic groundwater contamination. Extents of TCE contamination at the SIA for all of the three HSUs, based on data collected from 2002 through 2004, are presented on Figures 2-3 through 2-5 (SAIC 2008b). Metals COCs with concentrations exceeding ARARs were found to a much lesser extent at the SIA, primarily in the Landfill Area and Industrial Area at wells in areas of groundwater with strong reducing conditions (Tetra Tech, 2012b).

Based on current and historically high levels of TCE (greater than 10 mg/L) in some wells, dense non-aqueous-phase liquid (DNAPL) TCE may exist in the subsurface at the SIA. Earlier estimates of the total mass of TCE present in the subsurface ranged from 3 to 27 million pounds (SAIC, 2008b). More recent estimates suggest that the TCE mass is approximately 1.5 million pounds (Tetra Tech, 2012b) or approximately half of the lower end of the mass estimated previously. This refined mass estimate is based upon a more detailed evaluation of the existing data and inputting this information into a fate and transport modeling as reported in the FFS. Note that the modeling is a simplification of the complex subsurface environment. Considering the limited available data and uncertainties caution should be used when using this or any contaminant mass estimate (Tetra Tech, 2012b). The majority of the TCE mass is present in the residuum with lower proportions present in the weathered and unweathered bedrock units. Because of the highly complex hydrogeology in the area, it is difficult to quantify the fate and transport of contamination and the relationship between contamination in the source areas and concentrations present in CWS.

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Anniston Army Depot Southeast Industrial Area (Operable Unit No. 1) Anniston, Calhoun County, Alabama			
Action/Medium	*Requirements*	*Prerequisite*	*Citation*
	Water Quality		
Restoration of groundwater to its beneficial uses	May not exceed MCLs for organics or inorganics established under the Safe Drinking Water Act National Revised Primary Drinking Water Regulations for community water systems[1]	Presence of contaminants in groundwater of the State designated as potential sources of drinking water as defined in ADEM 335-6-8-.03 - **relevant and appropriate**	40 CFR 141.61(a) and (c)[2] 40 CFR 141.62(b)[2] AAC 335-7-2-.03(1) AAC 335-7-2-.04(1) AAC 335-7-2-.05(1)
Protection of surface water quality to meet designated uses	The quality of any waters receiving sewage, industrial wastes or other wastes, regardless of their use, shall be such as will not cause the best usage of any other waters to be adversely affected by such sewage, industrial wastes or other wastes.	Discharges to waters of the State of Alabama, as defined by AAC 335-6-10-.02(10) – **relevant and appropriate**	AAC 335-6-10-.05(1)
	Toxic substances; color producing; heated liquids; or other deleterious substances attributable to sewage, industrial wastes, or other wastes: only such amounts, whether alone or in combination with other substances, and only such temperatures as will not render the waters unsafe or unsuitable as a source of water supply for drinking or food-processing purposes, or exhibit acute toxicity or chronic toxicity, as	Discharges to waters of the State of Alabama classified for Public Water Supply (PWS) use, as defined by AAC 335-6-11-.02 – **relevant and appropriate**	AAC 335-6-10-.09(2)(e)(5)

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Action/Medium	*Requirements*	*Prerequisite*	*Citation*
	demonstrated by effluent toxicity testing or by application of numeric criteria given in rule 335-6-10-.07, to fish, wildlife and aquatic life, or adversely affect the aesthetic value of waters for any use under this classification.		
	There shall be no turbidity of other than natural origin that will cause substantial visible contrast with the natural appearance of waters or interfere with any beneficial uses which they serve. Furthermore, in no case shall turbidity exceed 50 Nephelometric units above background. Background will be interpreted as the natural condition of the receiving waters, without the influence of man-made or man-induced causes. Turbidity levels caused by natural runoff will be included in establishing background levels.	Discharges to waters of the State of Alabama classified for PWS use, as defined by AAC 335-6-11-.02 – **relevant and appropriate**	AAC 335-6-10-.09(2)(e)(9)
	Toxic substances attributable to sewage, industrial wastes, or other wastes: only such amounts, whether alone or in combination with other substances, as will not exhibit acute toxicity or chronic toxicity, as	Discharges to waters of the State of Alabama classified for fish and wildlife (F&W) use, as defined by AAC 335-6-11-.02 – **relevant and appropriate**	AAC 335-6-10-.09(5)(e)(5)

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	demonstrated by effluent toxicity testing or by application of numeric criteria given in rule 335-6-10-.07, to fish and aquatic life, including shrimp and crabs in estuarine or salt waters or the propagation thereof.		
	There shall be no turbidity of other than natural origin that will cause substantial visible contrast with the natural appearance of waters or interfere with any beneficial uses which they serve. Furthermore, in no case shall turbidity exceed 50 Nephelometric units above background. Background will be interpreted as the natural condition of the receiving waters without the influence of man-made or man-induced causes. Turbidity levels caused by natural runoff will be included in establishing background levels.	Discharges to waters of the State of Alabama classified for F&W use, as defined by AAC 335-6-11-.02 – **relevant and appropriate**	AAC 335-6-10-.09(5)(e)(9)
Protection of surface water classified for F&W use, as defined by AAC 335-6-11-.02	Concentrations of toxic pollutants in State waters shall not exceed the criteria indicated to the extent commensurate with the designated usage of such waters.	Discharges of toxic pollutants to waters of the State – **relevant and appropriate**	AAC 335-6-10-.07(1), Tbl. 1

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Anniston Army Depot Southeast Industrial Area (Operable Unit No. 1) Anniston, Calhoun County, Alabama			
Action/Medium	*Requirements*	*Prerequisite*	*Citation*
	Waste Generation, Characterization, and Storage – Primary and Secondary Wastes		
Characterization of solid waste (all primary and secondary wastes)	Must determine if a solid waste is excluded from regulation under 40 CFR 261.4; and Must determine if a solid waste is listed as a hazardous waste under Subpart D 40 CFR Part 261; or Must determine whether waste is characteristic waste identified in Subpart C by either: (1) Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or (2) Applying the knowledge of the hazard characteristic of the waste in light of the materials or process used.	Generation of solid waste as defined in 40 CFR 261.2, and determined not to be excluded - **applicable**	40 CFR 262.11[2] AAC 335-14-3-.01(2)
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be hazardous waste – **applicable**	40 CFR 262.11(d)[2] AAC 335-14-3-.01(2)(d)
Characterization of	Must conduct a detailed chemical and	Generation of RCRA hazardous	40 CFR 264.13(a)(1)[2]

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Action/Medium	*Requirements*	*Prerequisite*	*Citation*
hazardous waste (all primary and secondary wastes)	physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	waste for storage, treatment or disposal - **applicable**	AAC 335-14-5-.01(1)(j)(2)
Characterization of hazardous waste	Must determine if the hazardous waste meets the treatment standards in 40 CFR 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods or use of generator knowledge of waste.	Generation of hazardous waste for storage, treatment or disposal - **applicable**	40 CFR 268.7(a)[2] AAC 335-14-9-.01
Determination for management of hazardous waste	Must determine each EPA Hazardous Waste Number (waste code) applicable to the waste in order to determine the applicable treatment standards under 40 CFR 268 *et seq.*	Generation of hazardous waste for storage, treatment or disposal - **applicable**	40 CFR 268.9(a)[2] AAC 335-14-9-.01
	Must determine the underlying hazardous constituents [as defined in 40 CFR268.2(i)] in the characteristic waste	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal - **applicable**	40 CFR 268.9(a)[2] AAC 335-14-9-.01

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Action/Medium	***Requirements***	***Prerequisite***	***Citation***
Characterization of industrial wastewater	Industrial wastewater discharges that are point source discharges subject to regulation under section 402 of the Clean Water Act, as amended, are not solid wastes for the purpose of hazardous waste management. [Comment: This exclusion applies only to the actual point source discharge. It does not exclude industrial wastewaters while they are being collected, stored or treated before discharge, nor does it exclude sludges that are generated by industrial wastewater treatment.]	Generation of industrial wastewater and discharge into surface water – **applicable**.	40 CFR 261.4(a)(2)[2] AAC 335-14-2-.01(4)(a)(2)
	NOTE: For purpose of this exclusion, the CERCLA on-site treatment system for extracted VOCs and groundwater will be considered equivalent to a wastewater treatment unit and the point source discharges subject to regulation under CWA Section 402, provided the effluent meets all identified CWA ARARs.	[**NOTE:** In order to use the above row along with explanatory note the CERCLA action must include a CERCLA on-site WWTU which discharges into surface water. The discharge, which otherwise would be subject to regulation under CWA Section 402, must	

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		meet all identified CWA ARARs including effluent limitations.]	
Waste Storage – Primary Waste (e.g., excavated soils/sediments, sludge, debris) and Secondary Wastes (e.g., treatment residuals)			
Temporary onsite storage of remediation waste in containers	Containers must comply with 40 CFR 265.171-173; and The date upon which accumulation begins is clearly marked and visible for inspection on each container; and Container is marked with the words "hazardous waste"; or container may be marked with other words that identify the contents.	Accumulation of RCRA hazardous waste as defined in 40 CFR 260.10 - **applicable**	40 CFR 262.34(a)(1)(i)[2] AAC 335-14-3-.03(5)(a)(1)(i) 40 CFR 262.34(a)(2) & (3)[2] AAC 335-14-3-.03(5)(a)(2) & (3)
	Must close the unit in a manner that: • Minimizes the need for further maintenance. • Controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition		40 CFR 265.111(a)[2] 40 CFR 265.111(b)[2] AAC 335-14-3-.03(5)(a)(5) AAC 335-14-6-.07(2)

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	products to ground or surface waters or to the atmosphere. • Complies with closure requirements of 335-14-6-.09(9).		
	All contaminated equipment, structures, and soil must be properly disposed of, or decontaminated.		40 CFR §265.114[2] AAC 335-14-6-.07(5)
	At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous waste residues must be decontaminated or removed.		AAC 335-14-6-.09(9)
	Containers must comply with 40 CFR 265.171-173; and Container is marked with the words “hazardous waste”; or container may be marked with other words that identify the contents.	Accumulation of 55 gal. or less of RCRA hazardous waste <u>or</u> one quart of acutely hazardous waste listed in 261.33(e) at or near any point of generation – **applicable**	40 CFR 262.34(c)(1)[2] AAC 335-14-3-.03(5)(c)(1)
Transport and conveyance of	Any dedicated tank systems, conveyance systems, and ancillary equipment used to	On-site wastewater treatment unit (as defined in 40 CFR	40 CFR 264.1(g)(6)

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collected RCRA wastewater to WWTU located on the facility	treat, store or convey wastewater to an on–site NPDES–permitted wastewater treatment facility are exempt from the requirements of RCRA Subtitle C standards.	260.10) subject to regulation under § 402 or § 307(b) of the CWA (i.e., NPDES–permitted) that manages hazardous wastewaters – **applicable**.	
	NOTE: For purposes of this exclusion, any dedicated tank systems, conveyance systems, and ancillary equipment used to treat, store or convey CERCLA remediation wastewater to a CERCLA on –site wastewater treatment unit that meets all of the identified CWA ARARs for point source discharges from such a facility, are exempt from the requirements of RCRA Subtitle C standards.	[**NOTE:** In order to use the above row along with explanatory note the CERCLA action must include a CERCLA on–site WWTU which discharges into surface water. The discharge, which otherwise would be subject to regulation under CWA Section 402, must meet all identified CWA ARARs including effluent limitations.]	
Use and management of hazardous waste in containers	If container is not in good condition (e.g., severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition	Storage of RCRA hazardous waste in containers - **applicable**	40 CFR 264.171[2] AAC 335-14-5-.09(2)
Use and management of hazardous waste in	Use container made or lined with materials compatible with waste to be stored so that the	Storage of RCRA hazardous waste in containers - **applicable**	40 CFR 264.172[2]

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containers	ability of the container is not impaired.		AAC 335-14-5-.09(3)
Use and management of hazardous waste in containers	Keep containers closed during storage, except to add/remove waste. Open, handle and store containers in a manner that will not cause containers to rupture or leak.	Storage of RCRA hazardous waste in containers - **applicable**	40 CFR 264.173[2] AAC 335-14-5-.09(4)(a)&(b)
Use and management of hazardous waste in containers	Containers having capacity greater than 30 gallons must not be stacked over two containers high.	Storage of RCRA hazardous waste in containers - **applicable**	AAC 335-14-5-.09(4)(c)
Storage of hazardous waste in container area	Area must have a containment system designed and operated in accordance with 40 CFR 264.175(b)(1)-(5)	Storage of RCRA hazardous waste in containers with free liquids - **applicable**	40 CFR 264.175(a)[2] AAC 335-14-5-.09(6)(a)
Storage of hazardous waste in container area	Area must be sloped or otherwise designed and operated to drain liquid resulting from precipitation, or Containers must be elevated or otherwise protected from contact with accumulated liquid.	Storage of RCRA hazardous waste in containers that do not contain free liquids (other than F020,F021, F022, F023, F026, and F027) - **applicable**	40 CFR 264.175(c)(1) & (2)[2] AAC 335-14-5-.09(6)(c)(1)& (2)
Management of hazardous waste	Must comply with the general requirements for security (40 CFR §264.14; 335-14-5-.02(5)); ignitable, reactive, and incompatible wastes (40 CFR §264.17; 335-14-5-.02(8)) and location standards (40 CFR §264.18;	An owner or operator who stores hazardous waste — **applicable**	40 CFR 264.14[2] 40 CFR 264.17[2] 40 CFR 264.18[2] AAC 335-14-5-.02(5), (8), and (9)

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	335-14-5-.02(9))		
Closure of RCRA container storage unit	At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases and soils containing or contaminated with hazardous waste and hazardous waste residues must be decontaminated or removed. [Comment: At closure, as throughout the operating period, unless the owner or operator demonstrate in accordance with 40 CFR 261.3(d) that the solid waste removed from the containment system is not a hazardous waste, the owner or operator becomes a generator of hazardous waste an must manage it in accordance with all applicable requirements of parts 262 through 266.]	Storage of RCRA hazardous waste in containers in a unit with a containment system - **applicable**	40 CFR 264.178[2] AAC 335-14-5-.09(9)(a)
	Must close the unit in a manner that: • Minimizes the need for further maintenance. • Controls, minimizes, or eliminates to the		40 CFR 264.111(a)[2] 40 CFR 264.111(b)[2] AAC 335-14-5-.07(2)(a) AAC 335-14-5-.07(2)(b)

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	extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to ground or surface waters or to the atmosphere.		
	All contaminated equipment, structures, and soil must be properly disposed of, or decontaminated.		40 CFR 264.114[2] AAC 335-14-5-.07(5)
Waste Treatment and Disposal — Contaminated Groundwater, Excavated Soils, Debris, and Secondary Wastes			
Discharge of treated groundwater to surface water	Comply with any applicable substantive water quality requirements under the Alabama Water Pollution Control Act (AWPCA) or the Clean Water Act (CWA) including application of technology- or ambient water quality- based effluent limitations to ensure discharge does not cause or contribute to violation of water quality standards.	Discharge of pollutants into surface waters – **applicable**	AAC 335-6-6-.04(f), (h), (i), and (j)
	Conditions for the discharge shall meet the requirements, as appropriate, provided in		40 CFR 122.44(a), (b), (d)[2] AAC 335-6-6-.14 (3)(a), (b), (e)

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	AAC 335-6-6-.14 such as the following: • Technology based effluent limitations and standards based on effluent limitations and standards promulgated under Sections 301 of the [CWA], or case-by-case effluent limitations determined under Section 402(a)(1) of the [CWA] when technology based standards or new source performance standards have not been promulgated, or on a combination of the two. • Other applicable effluent limitations and standards under Sections 301, 302, 303, 304, 307, 318, and 405 of the [CWA] and applicable effluent guidelines and standards under 40 CFR Subchapter N.; and • Other requirements in addition to or more stringent than promulgated effluent limitations, guidelines, or standards under Sections 301, 306, 307, 318, and 405 of the Clean Water Act where		

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	necessary to achieve water quality standards established under Section 303 of the Clean Water Act and AWPCA §2-22-9(g)		
	Limitations must be applied to control all pollutants or pollutant parameters that are or may be discharged at a level which cause, have reasonable potential to cause or contribute to an exceedance of a narrative or numerical water quality standard.		AAC 335-6-6-.14(e)(1)(i)
	Take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of effluent standards which has the reasonable likelihood of adversely affecting human health and the environment.		40 CFR 122.41(d)[2] AAC 335-6-6-.12(d)
	Properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with effluent standards. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality		40 CFR 122.41(e)[2] AAC 335-6-6-.12(e)

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	assurance procedures.		
Technology-based treatment requirements for wastewater discharge	To the extent that EPA promulgated effluent limitations are inapplicable, shall develop on a case-by-case Best Professional Judgment (BPJ) basis under § 402(a)(1)(B) of the CWA, technology-based effluent limitations by applying the factors listed in 40 CFR 125.3(d) and shall consider: • The appropriate technology for this category or class of point sources, based upon all available information; and • Any unique factors relating to the discharge.		40 CFR 125.3(c)(2)
Water-quality-based effluent limits for wastewater discharge	Must develop water-quality-based effluent limits that ensure: • The level of water quality to be achieved by limits on point sources established under this paragraph is derived from, and complies with all applicable water quality standards; and • Effluent limits developed to protect a	Discharge of pollutants to surface waters that causes, or has reasonable potential to cause, or contributes to an instream excursion above a narrative or numeric criteria within a State water quality standard established under § 303 of the CWA - **applicable**	40 CFR 122.44(d)(1)(vii)

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	narrative water quality criterion, a numeric water quality criterion, or both, are consistent with the assumptions and requirements of any available wasteload allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7.		
	Must attain or maintain a specified water quality through water-quality-related effluent limits established under § 302 of the CWA.		40 CFR 122.44(d)(2)[2] AAC 335-6-6-.14(e)(2)
Disposal of RCRA characteristic wastewaters in an NPDES permitted WWTU	Are not prohibited, if the wastes are managed in a treatment system which subsequently discharges to waters of the U.S. pursuant to a permit issued under 402 the CWA (i.e., NPDES permitted), unless the wastes are subject to a specified method of treatment other than DEACT in 40 CFR 268.40, or are D003 reactive cyanide.	Land disposal of RCRA restricted hazardous wastewaters that hazardous only because they exhibit a characteristic and are not otherwise prohibited under 40 CFR 268 – **applicable**	40 CFR 268.1(c)(4)(i)[2] AAC 335-14-9-.01
	NOTE: For purposes of this exclusion, a CERCLA on–site wastewater treatment unit that meets all of the identified CWA ARARs for point source discharges from such a	[**NOTE:** In order to use the above row along with explanatory note the CERCLA action must include a CERCLA	

TABLE 2-3

**CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
AND TO-BE- CONSIDERED GUIDANCE (TBC)
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Anniston Army Depot Southeast Industrial Area (Operable Unit No. 1) Anniston, Calhoun County, Alabama			
Action/Medium	***Requirements***	***Prerequisite***	***Citation***
	system, is considered a wastewater treatment system that is NPDES permitted.	on –site WWTU which discharges into surface water. The discharge, which otherwise would be subject to regulation under CWA Section 402, must meet all identified CWA ARARs including effluent limitations.]	
Waste Transportation – Primary and Secondary Wastes			
Transportation of waste on-site	The generator requirements of 40 CFR 262.20-262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way	Transportation of hazardous wastes on s public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way - **applicable**	40 CFR 262.20(f)
Transportation of waste off-site	Must comply with the generator requirements of 40 CFR 262.30 for packaging, Sec. 262.31 for labeling, Sec. 262.32 for marking, Sec. 262.33 for placarding,.	Preparation and initiation of shipment of hazardous waste off-site - **applicable**	40 CFR 262.10(h)[2] AAC 335-14-3-.03(1), (2), (3) & (4), 335-14-3-.04(1)
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of HTMA and HMR at	Any person who, under contract with a department or agency of	49 CFR 171.1(b)

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO-BE- CONSIDERED GUIDANCE (TBC)
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Anniston Army Depot Southeast Industrial Area (Operable Unit No. 1) Anniston, Calhoun County, Alabama			
Action/Medium	*Requirements*	*Prerequisite*	*Citation*
	49 CFR 171-180 related to marking, labeling, placarding, packaging, emergency response, etc.,.	the federal government, transports "in commerce," or causes to be shipped, a hazardous material - **applicable**	
Transportation of samples (*e.g.*, contaminated soils and wastewaters)	Except as provided in 40 C.F.R. § 261.4(d)(2), a sample of waste is not subject to any requirements of 40 C.F.R. Parts 261 through 268 or 270 provided that the requirements specified in subparagraphs d)(1) (i) through (iii) are complied with. Exemption does not apply if laboratory determines waste is hazardous but it no longer meeting conditions in paragraph (d)(1).	Samples of solid waste or a sample of water, soil for purpose of conducting testing to determine its characteristics or composition – **applicable**	40 CFR 261.4 (d)
Pre-transportation Packaging requirements for generators of hazardous waste	Before transporting or offering for transport offsite, a generator must package waste in accordance with the applicable U.S. DOT regulations on packaging under 49 CFR Parts 173, 178, and 179.	An owner or operator who initiates a shipment of hazardous waste from a treatment, storage, or disposal facility — **applicable**	40 CFR 262.30[2] AAC 335-14-3-.03(1)
Pre-transportation labeling requirements for generators of hazardous waste	Before transporting hazardous waste or offering hazardous waste for transportation offsite, a generator must label each package in accordance with the applicable U.S. DOT	An owner or operator who initiates a shipment of hazardous waste from a treatment, storage, or disposal	40 CFR 262.31[2] AAC 335-14-3-.03(2)

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
AND TO-BE- CONSIDERED GUIDANCE (TBC)
IROD AMENDMENT
OPERABLE UNIT 1
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Anniston Army Depot Southeast Industrial Area (Operable Unit No. 1) Anniston, Calhoun County, Alabama			
Action/Medium	*Requirements*	*Prerequisite*	*Citation*
	regulations on hazardous materials under 49 CFR Part 172.	facility — **applicable**	
Pre-transportation marking requirements for generators of hazardous waste	Before transporting hazardous waste or offering hazardous waste for transportation offsite, a generator must mark each package of hazardous waste in accordance with the applicable U.S. DOT regulations on hazardous materials under 49 CFR Part 172.	An owner or operator who initiates a shipment of hazardous waste from a treatment, storage, or disposal facility — **applicable**	40 CFR 262.32(a)[2] AAC 335-14-3-.03(3)(a)
Pre-transportation marking requirements for generators of hazardous waste	Before transporting hazardous waste or offering hazardous waste for transportation offsite, a generator must mark each container of 119 gallons or less used in such transportation with the information displayed in accordance with the requirements of 49 CFR 172.304.	An owner or operator who initiates a shipment of hazardous waste from a treatment, storage, or disposal facility — **applicable**	40 CFR 262.32(b)[2] AAC 335-14-3-.03(3)(b)
Groundwater Monitoring/Extraction Well/Injection Well Installation			
Construction of extraction wells	All materials used in the construction of a well shall have the structural strength to accomplish the purpose for which they are installed.	Installation of wells as defined in EPA Region 4's Guidance Document SESDGUID-101-R1 "Design and Installation of Monitoring Wells" and ADEM's "Alabama Environmental and Restoration Guidance, Appendix	EPA Region 4's Guidance Document SESDGUID-101-R1 Design and Installation of Monitoring Wells, ADEM's Alabama Environmental and Restoration Guidance, Appendix B

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO-BE- CONSIDERED GUIDANCE (TBC) IROD AMENDMENT OPERABLE UNIT 1 ANNISTON ARMY DEPOT, ANNISTON, ALABAMA PAGE 20 OF 26

Anniston Army Depot Southeast Industrial Area (Operable Unit No. 1) Anniston, Calhoun County, Alabama			
Action/Medium	***Requirements***	***Prerequisite***	***Citation***
		B" - **to be considered**	
	Any holes remaining after construction or testing attempts shall be properly backfilled		EPA Region 4's Guidance Document SESDGUID-101-R1 Design and Installation of Monitoring Wells, ADEM's Alabama Environmental and Restoration Guidance, Appendix B
Construction of monitoring wells	Must be cased in a manner that maintains the integrity of the monitoring well bore hole. This casing must be screened or perforated, and packed with gravel or sand where necessary, to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space (*i.e.*, the space between the bore hole and well casing) above the sampling depth must be sealed with a suitable material (*e.g.*, cement grout or bentonite slurry) to prevent contamination of samples and the groundwater.	Installation of groundwater monitoring wells at a RCRA facility in order to detect any statistically significant amounts of hazardous waste or hazardous waste constituents – to be considered	EPA Region 4's EPA Region 4's Guidance Document SESDGUID-101-R1 Design and Installation of Monitoring Wells, ADEM's Alabama Environmental and Restoration Guidance, Appendix B

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO-BE- CONSIDERED GUIDANCE (TBC)
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
PAGE 21 OF 26

Anniston Army Depot *Southeast Industrial Area (Operable Unit No. 1)* *Anniston, Calhoun County, Alabama*			
Action/Medium	***Requirements***	***Prerequisite***	***Citation***
	Monitoring wells must be operated and maintained in a manner to prevent soil, surface water, and/or groundwater contamination. This requirement includes the installation of protective barriers around monitoring wells where necessary to prevent damage to the well from traffic or other causes. All monitoring wells must have functional key or combination locks on the wellhead covers to prevent unauthorized access. All monitoring wells must be assigned an identifying number by the facility, and such numbers must be permanently affixed to the outer casing of each monitoring well.		
Abandonment of extraction wells, monitoring wells, and boreholes	Any well to be abandoned shall be permanently sealed in the following manner: The well must be filled with a puddled clay material containing 50 ppm of chlorine to within 20 feet of the top of the well. The top 20 feet shall be filled with cement grout or	Abandonment of extraction wells, monitoring wells, and boreholes – to be considered	EPA Region 4's Guidance Document SESDGUID-101-R1 Design and Installation of Monitoring Wells, ADEM's Alabama Environmental and Restoration Guidance, Appendix B

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
AND TO-BE- CONSIDERED GUIDANCE (TBC)
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Anniston Army Depot *Southeast Industrial Area (Operable Unit No. 1)* *Anniston, Calhoun County, Alabama*			
Action/Medium	***Requirements***	***Prerequisite***	***Citation***
	concrete.		
Activity associated with Class V injection wells	Injection activity cannot allow the movement of fluid containing any contaminant into drinking water, if the presence of that contaminant may cause a violation of the primary drinking water standards under 40 CFR part 141, other health based standards, or may otherwise adversely affect the health of persons.	Construction, operation, maintenance, conversion, plugging, or closure of Class V injection wells associated with remedial activity – **relevant and appropriate**	40 CFR 144.82(a)(1)[2] AAC 335-6-8-.05(1)(d)
Plugging and abandonment of Class V injection wells	Shall close the well in a manner that prevents the movement of fluid containing any contaminant into an underground source of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR Part 141 or may otherwise adversely affect the health of persons.	Operation of a Class V injection well – **relevant and appropriate**	40 CFR 146.10(c)(1)
	Shall dispose of or otherwise manage any soil, gravel, sludge, liquids, or other materials removed from or adjacent to the well in accordance with all applicable Federal, State, and local regulations and requirements.		40 CFR 146.10(c)(2)

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
AND TO-BE- CONSIDERED GUIDANCE (TBC)
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Anniston Army Depot Southeast Industrial Area (Operable Unit No. 1) Anniston, Calhoun County, Alabama			
Action/Medium	*Requirements*	*Prerequisite*	*Citation*
General Construction Standards – Land Disturbing Activities			
Activities causing storm water runoff (*e.g.*, clearing, grading, excavation)	Shall fully implement and regularly maintain effective best management practices (BMPs) to the maximum extent practicable, and in accordance with the operator's Construction Best Management Practices Plan (CBMPP). Appropriate, effective pollution abatement/prevention facilities, structural and nonstructural BMPs, and management strategies shall be fully implemented prior to and concurrent with commencement of the regulated activities and regularly maintained during construction as needed at the site to meet or exceed the requirements of this chapter until construction is complete, effective reclamation and/or stormwater quality remediation is achieved.	All new and existing construction activities as defined in AAC 335-6-12-.02(e) disturbing one (1) acre or more in size - **applicable**	AAC 335-6-12-.05(2)
	The operator shall takes all reasonable steps to prevent and/or minimize, to the extent practicable, any discharge in violation of this chapter or which has a reasonable likelihood of adversely affecting the quality of		AAC 335-6-12-.06(4)

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
AND TO-BE- CONSIDERED GUIDANCE (TBC)
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Anniston Army Depot Southeast Industrial Area (Operable Unit No. 1) Anniston, Calhoun County, Alabama			
Action/Medium	*Requirements*	*Prerequisite*	*Citation*
	groundwater or surface water receiving the discharge(s).		
	Implement a comprehensive CBMPP appropriate for site conditions consistent with the substantive requirements of AAC 335-6-12-.21 that has been prepared and certified by a Qualified Credentialed Professional (QCP)		AAC 335-6-12-.21(2)(a)
	The CBMPP shall include a description of appropriate, effective water quality BMPs to be implemented at the site to ensure compliance with this chapter and include but not limited to the measures provided in subsections 1 through 14.		AAC 335-6-12-.21(2)(b)
	BMPs shall be designed, implemented, and regularly maintained to provide effective treatment of discharges of pollutants in stormwater resulting from runoff generated by probably storm events expected/predicted during construction disturbance based on historic precipitation information, and during extended periods of adverse weather and seasonal conditions.		AAC 335-6-12-.21(4)

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO-BE- CONSIDERED GUIDANCE (TBC)
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Anniston Army Depot *Southeast Industrial Area (Operable Unit No. 1)* *Anniston, Calhoun County, Alabama*			
Action/Medium	*Requirements*	*Prerequisite*	*Citation*
Presence of federally endangered or threatened species, as designated in 50 CFR 17.11 and 17.12 **-or-** critical habitat of such species listed in 50 CFR 17.95	Actions that jeopardize the existence of a listed species or results in the destruction or adverse modification of critical habitat must be avoided or reasonable and prudent mitigation measures taken.	Action that is likely to jeopardize fish, wildlife, or plant species or destroy or adversely modify critical habitat [Pygmy sculpin (*Cottus paulus*)]—**applicable**	16 USC 1538(a)[2] AAC 335-13-4-.01(1)(b)
	Each Federal agency shall, in consultation with and with the assistance of the Secretary [of DOI], insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by [DOI] to be critical.	Actions authorized, funded, or carried out by any Federal agency, pursuant to 16 USC 1536 – **relevant and appropriate**	16 USC 1536(a)(2); 50 CFR 402.13(a), 402.14

TABLE 2-3

CHEMCIAL AND ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO-BE- CONSIDERED GUIDANCE (TBC)
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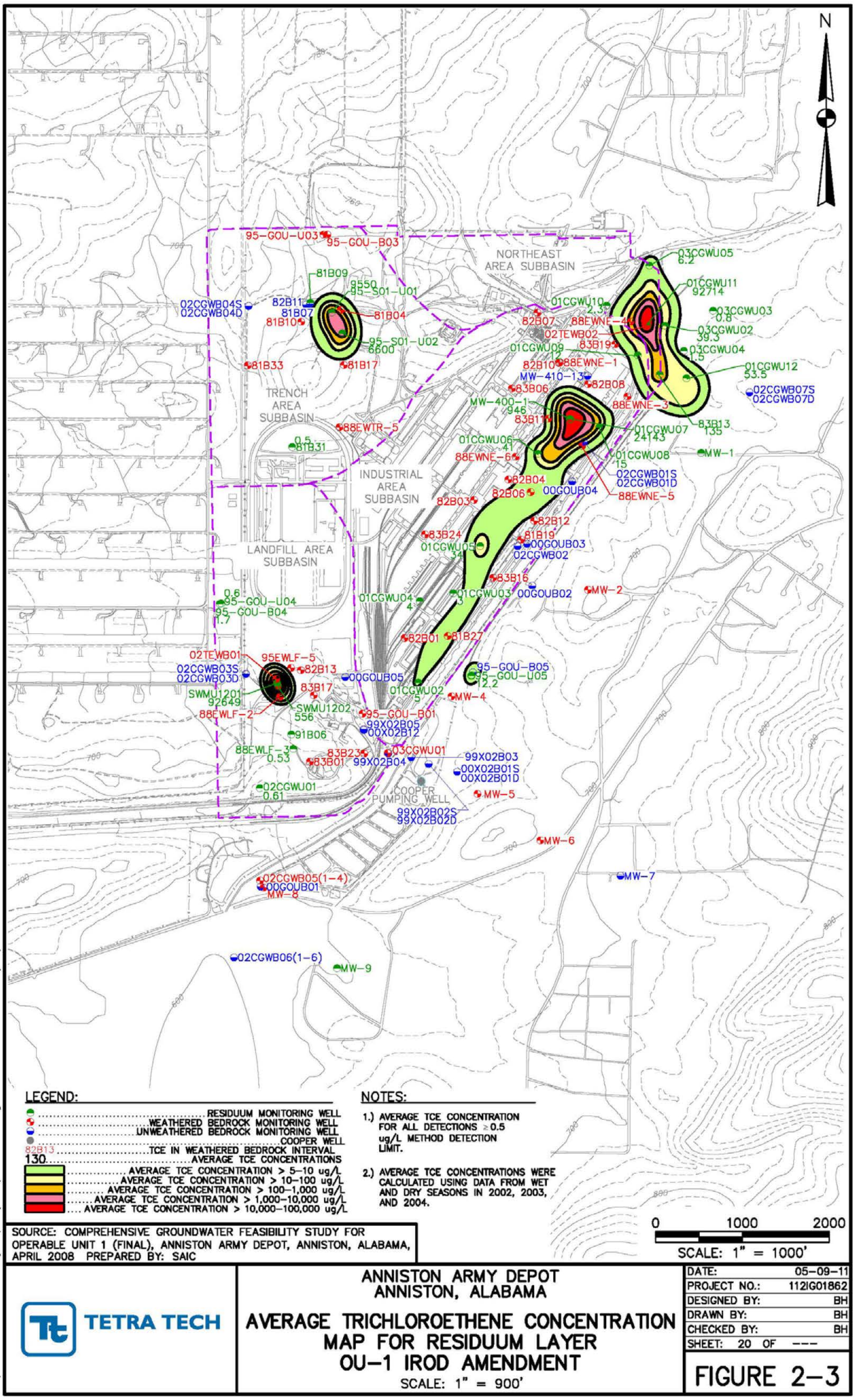
Footnote

1 Under CERCLA Section 121(d)(4), the MCLs in Table 2-6 will not be met due to the interim nature of this action.

2 The NCP definitions of “applicable” or “relevant and appropriate” requirements at 40 C.F.R. § 300.5 include only those state environmental standards that are more stringent than the federal standards. In cases where the state regulations are part of a federally-authorized program, the state regulations are recognized as federal requirements. Both the federal and state citations are listed here to demonstrate equivalence between the federal and state citations.

ADEM = Alabama Department of Environmental Management
ARAR = applicable or relevant and appropriate requirement
AWPCA = Alabama Water Pollution Control Act
CFR = *Code of Federal Regulations*
CWA = Clean Water Act
DoD = Department of Defense
DOI = U.S. Department of the Interior
EPA = U.S. Environmental Protection Agency
F&W = Fish and Wildlife
MCL = maximum contaminant level
MNA = monitored natural attenuation
PWS = Public Water Supply
RCRA – Resource Conservation and Recovery Act
TBC = To Be Considered
UIC = underground injection control
USC = U.S. Code
$>$ = greater than
$<$ = less than
$\geq$ = greater than or equal to
$\leq$ = less than or equal to


N
NORTHEAST AREA SUBBASIN
TRENCH AREA SUBBASIN
INDUSTRIAL AREA SUBBASIN
LANDFILL AREA SUBBASIN
COOPER PUMPING WELL
95-GOU-U03
95-GOU-B03
81B09
9550
95-S01-U01
02CGWB04S
02CGWB04D
82B11
81B07
81B10
81B04
95-S01-U02
6600
81B33
81B17
88EWTR-5
0.5
81B31
03CGWU05
6.2
01CGWU11
92714
03CGWU03
0.8
03CGWU02
39.3
03CGWU04
1.5
01CGWU12
53.5
02CGWB07S
02CGWB07D
01CGWU10
2.3
82B07
88EWNE-4
02TEWB02
83B19
01CGWU09
82B10
88EWNE-1
MW-410-13
82B08
83B06
MW-400-1
946
83B11
88EWNE-3
83B13
135
01CGWU07
24143
01CGWU06
41
88EWNE-6
01CGWU08
15
MW-1
02CGWB01S
02CGWB01D
88EWNE-5
82B04
82B06
00GOUB04
82B03
82B12
83B24
01CGWU05
34
81B19
00GOUB03
02CGWB02
83B16
01CGWU03
3
00GOUB02
MW-2
01CGWU04
4
0.6
95-GOU-U04
95-GOU-B04
1.7
82B01
81B27
95-GOU-B05
95-GOU-U05
12.2
02TEWB01
95EWLF-5
02CGWB03S
02CGWB03D
82B13
00GOUB05
SWMU1201
92649
83B17
01CGWU02
5
MW-4
88EWLF-2
SWMU1202
556
95-GOU-B01
99X02B05
00X02B12
91B06
88EWLF-3
0.53
83B23
03CGWU01
83B01
99X02B04
99X02B03
00X02B01S
00X02B01D
02CGWU01
0.61
MW-5
99X02B02S
99X02B02D
MW-6
MW-7
02CGWB05(1-4)
00GOUB01
MW-8
02CGWB06(1-6)
MW-9
LEGEND:
RESIDUUM MONITORING WELL
WEATHERED BEDROCK MONITORING WELL
UNWEATHERED BEDROCK MONITORING WELL
COOPER WELL
82B13 TCE IN WEATHERED BEDROCK INTERVAL
130 AVERAGE TCE CONCENTRATIONS
AVERAGE TCE CONCENTRATION > 5-10 ug/L
AVERAGE TCE CONCENTRATION > 10-100 ug/L
AVERAGE TCE CONCENTRATION > 100-1,000 ug/L
AVERAGE TCE CONCENTRATION > 1,000-10,000 ug/L
AVERAGE TCE CONCENTRATION > 10,000-100,000 ug/L
NOTES:
1.) AVERAGE TCE CONCENTRATION FOR ALL DETECTIONS ≥ 0.5 ug/L METHOD DETECTION LIMIT.
2.) AVERAGE TCE CONCENTRATIONS WERE CALCULATED USING DATA FROM WET AND DRY SEASONS IN 2002, 2003, AND 2004.
SOURCE: COMPREHENSIVE GROUNDWATER FEASIBILITY STUDY FOR OPERABLE UNIT 1 (FINAL), ANNISTON ARMY DEPOT, ANNISTON, ALABAMA, APRIL 2008 PREPARED BY: SAIC
0 1000 2000
SCALE: 1" = 1000'
TETRA TECH
ANNISTON ARMY DEPOT
ANNISTON, ALABAMA
AVERAGE TRICHLOROETHENE CONCENTRATION MAP FOR RESIDUUM LAYER
OU-1 IROD AMENDMENT
SCALE: 1" = 900'
DATE: 05-09-11
PROJECT NO.: 112IG01862
DESIGNED BY: BH
DRAWN BY: BH
CHECKED BY: BH
SHEET: 20 OF ---
FIGURE 2-3
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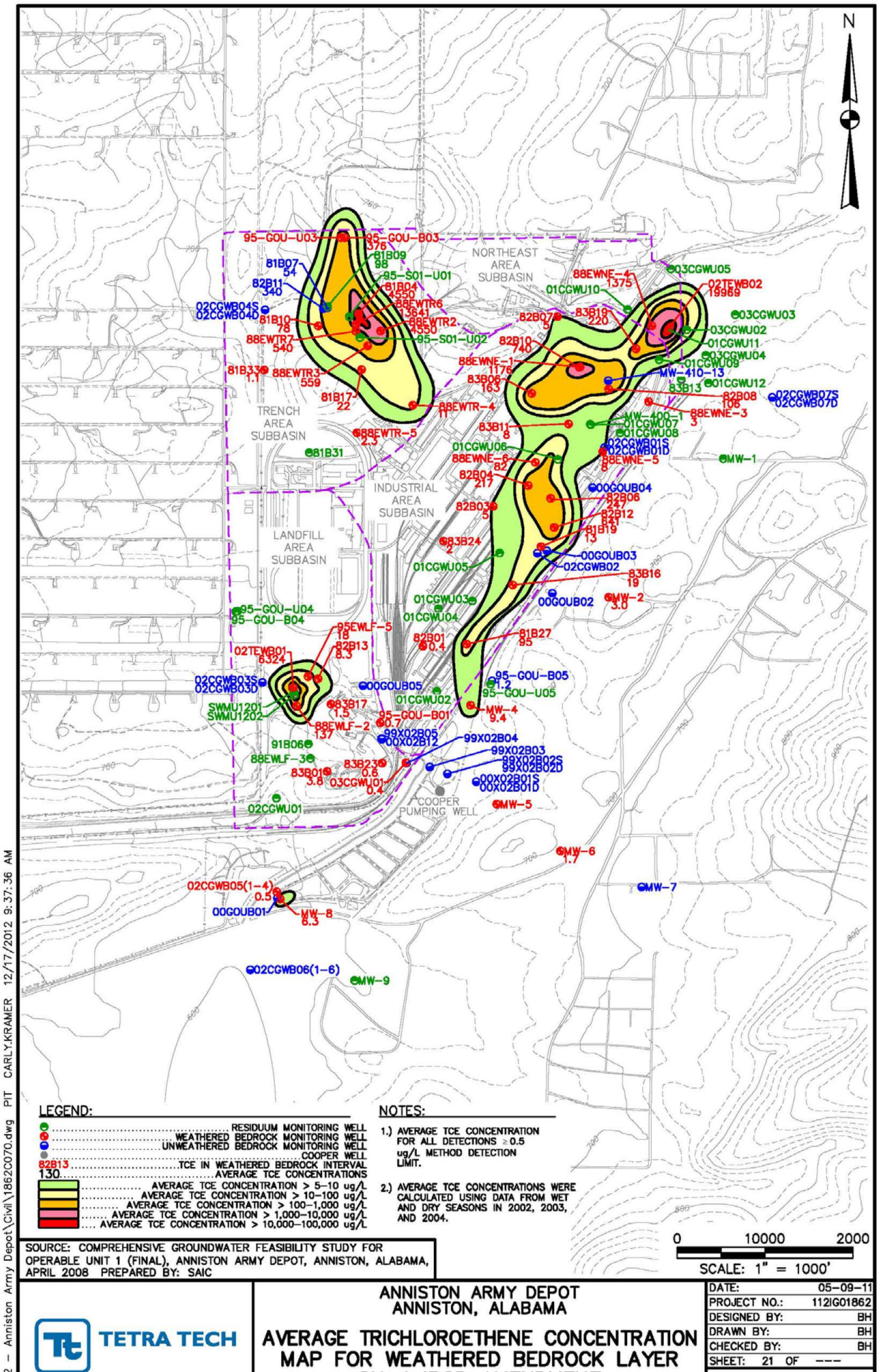

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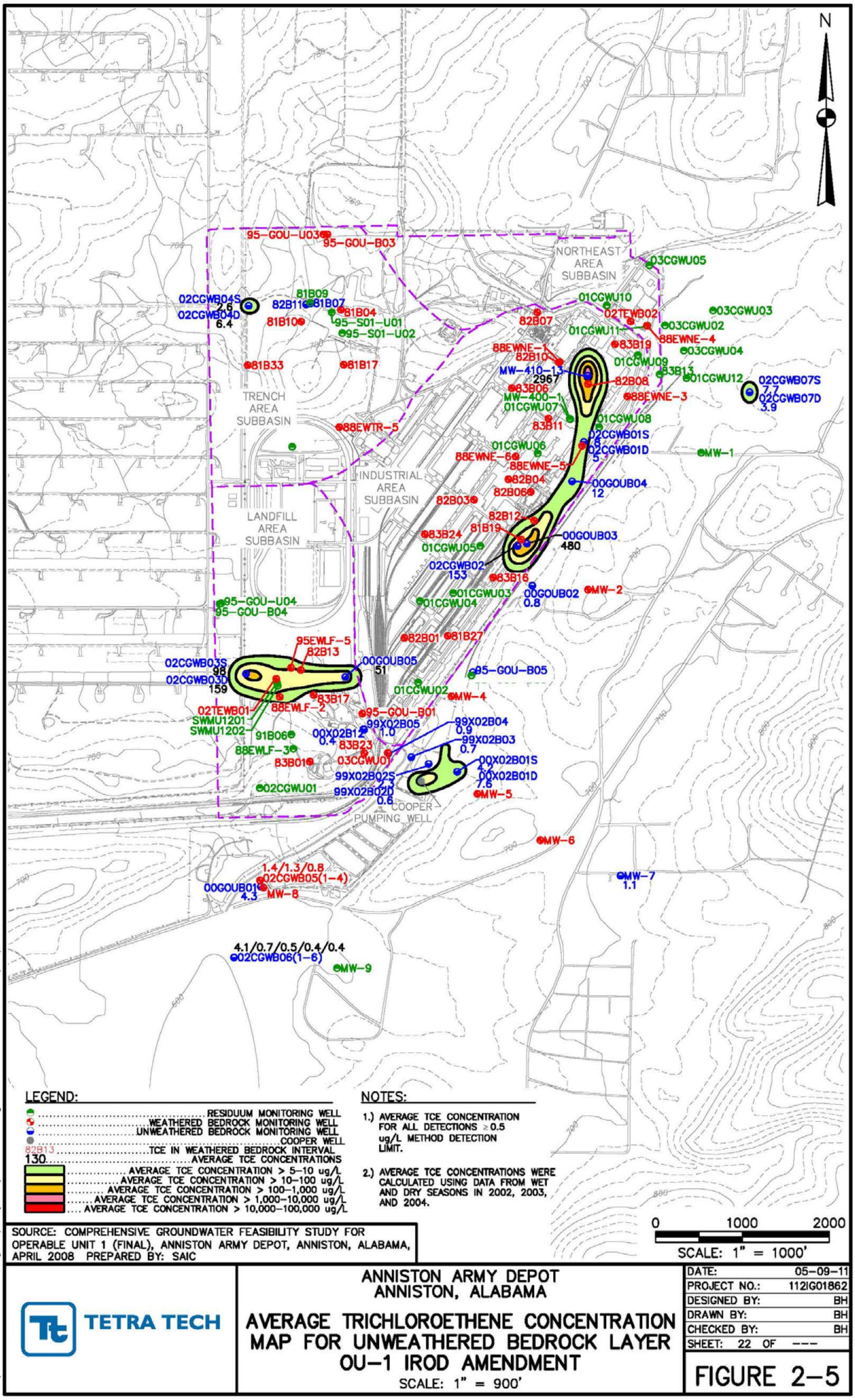

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2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

ANAD is an active military facility, and the SIA is currently used for a variety of industrial activities such as refurbishment, testing, and decommissioning of combat vehicles and various types of ordnance. There are no plans to change the industrial land use in the immediate or long-term future of the facility. Current and likely future land use adjacent to ANAD is residential.

Groundwater beneath ANAD travels off-post and discharges to Coldwater Spring. Under the current conditions, groundwater is not used at ANAD. Water is supplied to ANAD and the surrounding public from Krebs Water Treatment Plant (KWTP). The KWTP extracts water from CWS and treats it using air stripping prior to distribution to ANAD and the public. Off-site private wells exist at residences in the vicinity of ANAD; however, most residents obtain their water from the KWTP public water supply. ANAD is currently monitoring the private wells through a private well sampling program. In addition, three locations at CWS, the source of water for the KWTP, are monitored for volatile organic carbons (VOCs), BEHP, and COC metals on a monthly basis. TCE concentrations have consistently been detected and recently ranging between 5 and 7 ug/L in CWS thereby exceeding the Maximum Contaminant Level (MCL) of 5 µg/L for TCE and 2.4 ug/L the Alabama water quality criterion for TCE concentration in surface water for a public supply. As stated, KWTP uses air strippers to remove the VOCs in the water to non-detect levels. Samples have been collected on a monthly basis since approximately 2006 of the water treatment effluent. The post treatment results have shown that TCE concentrations were non-detect or below the *laboratory limit of detection (LOD), which is 0.25 µg/L µg/L.*

2.7 SUMMARY OF SITE RISKS

Risk assessments estimate what risks to receptors are present if no remedial action were taken, provide the basis for taking action, and identify the contaminants and exposure pathways that need to be addressed by the remedial action. Human health and ecological risk assessments were conducted as part of the Phase III RI (SAIC, 2008a). The HHRA was re-evaluated in 2012 using the same approach documented in the Phase III RI using more recent groundwater monitoring data from fall 2009 through 2011 to provide a more representative estimate of exposure to groundwater contaminants and to refine the COC list (Tetra Tech, 2012a). All receptors, exposure pathways, and exposure assumptions in the re-evaluation remained the same as those in the initial assessment in the RI. In addition, because the toxicity factors for TCE were finalized by EPA in 2011 and are different from the ones used in the RI (2008), the risks associated with TCE were also re-evaluated in 2012 to reflect the more recent toxicity factors. As a result of the COC refinement study, the updated COC list for OU-1 now includes only TCE, BEHP, methylene chloride, PCE, arsenic, chromium, lead, and manganese (Tetra Tech, 2012a). Additional discussion on the process completed can be found on page 2-44.

2.7.1 Summary of Human Health Risk

The HHRA re-evaluation was conducted using chemical concentrations detected in groundwater samples. Key steps in the risk assessment process included identification of chemicals of potential concern (COPCs), exposure assessment, toxicity assessment, and risk characterization.

Identification of COPCs

COPC identification in the Phase III RI HHRA was based on the results from the Phase II RI (SAIC, 1998a). Twelve chemicals were identified as COCs "at the SIA boundary" in the Phase II RI and were selected as COPCs in the Phase III RI. The 12 chemicals were aluminum, arsenic, beryllium, chromium, iron, lead, manganese, BEHP, carbon tetrachloride, chloroform, methylene chloride, and TCE. These COPCs were later retained as COCs in the Phase III RI after risk assessment and ARAR comparison. The same 12 chemicals were identified as COPCs and re-evaluated in the 2012 COC refinement technical memorandum (Tetra Tech, 2012a).

Exposure Assessment

During the exposure assessment, current and potential future exposure pathways through which humans might come into contact with the COPCs identified in the previous step were evaluated. Thirteen OU-1 exposure zones were identified in the HHRA in the Phase III RI:

On-Post:

- Northeast Area Sub-basin (includes the Northeast Source Area and downgradient wells)
- Northeast Source Area
- Industrial Area Sub-basin (includes the Industrial Source Area and downgradient wells)
- Industrial Source Area
- Landfill Area Sub-basin [includes the Solid Waste Management Unit (SWMU) 12 Source Area and downgradient wells]
- SWMU 12 Source Area (source area within the Landfill Area Sub-basin),
- Trench Area Sub-basin (includes the SWMU 1 Source Area and downgradient wells),
- SWMU 1 Source Area (source area within the Trench Area Sub-basin), and
- Western boundary of ANAD (Well 00X04B09S/D).

Off-Post:

- Off-post monitoring wells
- Off-post residential wells
- CWS
- Coldwater Creek picnic ground.

On-post, current and likely future land use type is industrial, and adult industrial workers (including ANAD office workers) are the receptors. For the hypothetical on-post residential land use scenario, child and adult residents are the receptors. Off-post, current and likely future land use is residential, and child and adult residents are the receptors. An off-post industrial worker scenario was also evaluated for workers using groundwater with contaminant levels represented by off-post monitoring well results. The exposure pathways for each exposure zone are summarized in Table 2-4.

For each exposure zone the exposure point concentrations (EPCs) were calculated separately for the shallow (i.e., residuum and weathered bedrock) and deep (i.e., unweathered bedrock) interval within the aquifer. The EPCs were calculated as the arithmetic mean of the COPC concentrations from the data collected from multiple sampling events from 1998 through 2004 based on the EPA Region 4 guidance (EPA, 2000). Standard equations and exposure assumptions were used in accordance with the EPA guidance.

As stated above, all receptors, exposure pathways, and exposure assumptions in the HHRA re-evaluation in 2012 remained the same as those in the Phase III RI.

TABLE 2-4

EXPOSURE PATHWAYS FOR THE HUMAN HEALTH RISK ASSESSMENT IN THE PHASE III RI
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Exposure Zone	Land Use	Receptor	Shallow Groundwater (Residuum/Weathered Bedrock)		Deep Groundwater (Unweathered Bedrock)		Spring Water		Soil Gas
				Showering		Showering		Showering	Indoor Air
			Ingestion	Derm/Inh	Ingestion	Derm/Inh	Ingestion	Derm/Inh	Inh
Onpost									
Northeast Area Sub-basin	Hypothetical Future	Industrial Worker	•						
	Hypothetical Future	Resident	•	•					•
Northeast Source Area	Hypothetical Future	Industrial Worker	•						
	Hypothetical Future	Resident	•	•					•
Industrial Area Sub-basin	Hypothetical Future	Industrial Worker	•		•				
	Hypothetical Future	Resident	•	•	•	•			•
Industrial Source Area	Hypothetical Future	Industrial Worker	•		•				
	Hypothetical Future	Resident	•	•	•	•			•
Landfill Area Sub-basin	Hypothetical Future	Industrial Worker	•		•				
	Hypothetical Future	Resident	•	•	•	•			•
SWMU 12 Source Area[a]	Hypothetical Future	Industrial Worker	•		•				
	Hypothetical Future	Resident	•	•	•	•			•
Trench Area Sub-basin	Hypothetical Future	Industrial Worker	•		•				
	Hypothetical Future	Resident	•	•	•	•			
SWMU 1 Source Area[b]	Hypothetical Future	Industrial Worker	•						
	Hypothetical Future	Resident	•	•					
Western Boundary of ANAD	Hypothetical Future	Industrial Worker			•				
	Hypothetical Future	Resident			•	•			
Offpost									
Offpost Monitoring Wells	Hypothetical Future	Industrial Worker	•		•				
	Hypothetical Future	Resident	•	•	•	•			
Offpost Residential Wells[c]	Hypothetical Future	Industrial Worker			•				
	Current and Likely Future	Resident			•	•			
Coldwater Spring[d]	Current and Likely Future	Industrial Worker					•		
	Current and Likely Future	Resident					•	•	
Coldwater Creek Picnic Ground[e]	Current and Likely Future	Industrial Worker							
	Current and Likely Future	Resident							

Empty boxes represent incomplete pathways.
[a] SWMU 12 Source Area is the source area within the Landfill Area Sub-basin.
[b] SWMU 1 Source Area is the source area within the Trench Area Sub-basin
[c] Offpost residential well risk assessment conducted based on comparison of site concentrations to applicable or relevant and appropriate requirements and risk-based criteria.
[d] Coldwater Spring is the current and expected future source of potable water for the Depot.
[e] At Coldwater Creek picnic ground, recreational exposure to the spring water will be evaluated qualitatively rather than quantitatively. ANAD = Anniston Army Depot.
Derm = Dermal contact.
Inh = Inhalation.
SWMU = Solid Waste Management Unit.

Toxicity Assessment

The toxicity assessment describes the quantitative relationship between the extent of exposure to a chemical and the types of injury or disease. This quantitative relationship generally takes the form of toxicity values that are identified for use in risk characterization. Important toxicity values include reference doses (RfDs) for oral exposure, reference concentrations (RfCs) for inhalation exposure, slope factors (SFs) for oral exposure and unit risk factors (URFs) for the inhalation route. The Phase III RI toxicity values were obtained using the following hierarchy in accordance with EPA guidance (EPA, 2003): (1) Integrated Risk Information System (IRIS) (EPA, 2005), (2) Provisional Peer-Reviewed Toxicity Values (PPRTVs) (EPA, 2004), and (3) other sources [e.g., Health Effects Assessment Summary Tables (EPA, 1997)]. In the HHRA re-evaluation, the same toxicity values were used, except for TCE, for which the toxicity values finalized by EPA in September 2011 were used.

Risk Characterization

Risk characterization combines exposure intakes with toxicity values to calculate noncancer hazard quotients (HQs) and cancer risks. The objective of the risk characterization was to determine whether exposure to COPCs associated with the groundwater exposure zones poses a risk that exceeds target levels for human health effects.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk (ECLR) is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where: risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer

CDI = chronic daily intake averaged over 70 years (in mg/kg-day)

SF = slope factor (in mg/kg-day^{-1})

These risks are probabilities that are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure (RME) estimate has a 1 in 1 million chance of developing cancer as a result of site-related exposure. This is referred to as an “excess lifetime cancer risk” (ELCR) because it would be in addition to the risks of cancer that individuals face from other causes, such as smoking or exposure to too much sun. The chance of an individual’s developing cancer from all other causes has been estimated to be as high as one in three. EPA’s generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., a lifetime) to an RfD derived for a similar exposure period. An RfD represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called an HQ. An HQ less than 1 indicates that a receptor’s dose of a single contaminant is less than the RfD and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all chemicals that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may be reasonably exposed. An HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI} / \text{RfD}$$

where: CDI = chronic daily intake
RfD = reference dose

CDIs and RFDs are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term).

To update the risk characterization in the Phase III RI (SAIC, 2008a), the HHRA re-evaluation (Tetra Tech, 2012a) calculated the risks for exposure to groundwater for the adult worker and adult and child residents using the updated EPCs and TCE toxicity values. For the 12 COCs retained in the Phase III RI, if the cumulative site cancer risk exceeds 10^{-4} or the cumulative HI exceeds 1 the risks for individual chemicals were examined. If the chemical cancer risk exceeds 10^{-6}, or the HQ is greater than 1, the unacceptable risks for the chemical are identified in Table 2-5 for each exposure zone. In addition, the maximum detection for each exposure zone were also compared to the ARARs, which include federal and Alabama MCLs, non-zero Maximum Contaminant Level Goals (MCLGs), and Secondary Maximum Contaminant Levels (SMCLs). If the maximum detection exceeded any of these ARARs, the chemical was also identified in Table 2-5.

COCs were then identified if the calculated risks exceed the regulatory target risk levels or the groundwater concentrations exceed the ARARs. For metals COCs, the newly developed background criteria were also considered in the identification of COCs (Tetra Tech, 2012a). As a result of the COC refinement study, the updated COC list for OU-1 includes TCE, BEHP, methylene chloride, PCE, arsenic, chromium, lead, and manganese (Tetra Tech, 2012a).

Evaluation of the subsurface vapor intrusion (VI) to indoor air pathway was limited in the Phase III RI HHRA because it only evaluated for hypothetical residents living within the SIA. The sampling program was limited in scope with the objective of identifying the potential for adverse effects resulting from this pathway rather than fully characterizing risks to all receptors. Therefore, a separate VI study was conducted in 2011 to further evaluate this issue. Data for the sub-slab vapor concentrations, soil vapor concentrations, and groundwater concentrations were collected for the VI study near three representative buildings in the most contaminated area of the SIA, where these buildings were assumed to have the potentially highest VI risk at the SIA. Then the VI Assessment was conducted using a multiple-lines-of-evidence approach through which the VI risks were calculated separately using sub-slab vapor concentrations, soil vapor concentrations, and groundwater concentrations. This data was evaluated using the Johnson and Ettinger Model (JEM) to determine risk under current industrial and potential future residential scenarios. The VI study concluded that VI risks were less than target levels for current industrial and potential future residential receptors (Tetra Tech, 2012c).

TABLE 2-5

IDENTIFICATIONS OF EXCEEDANCES OF TARGET RISK LEVELS AND ARARS
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Exposure Zone	Screened Interval	Aluminum(1)	Arsenic(2)	Beryllium(3)	Chromium(4)	Iron(5)	Lead(6)	Manganese(7)	BEHP(8)	Chloroform(9)	CarbonTetrachloride(10)	Methylene Chloride(11)	TCE(12)
Onpost													
Northeast Area Sub-basin	R/W		RI					RIA		R		R	RIA
Northeast Source Area	R/W		RI					RIA		R		R	RIA
Industrial Area Sub-basin	R/W	A	RI		RA	RA	A	RIA	A	R		A	RIA
	UW	A	RI		R	A		RA	A	R			RIA
Industrial Source Area	R/W	A	RI		RA	RA	A	RIA		R		A	RIA
	UW	A	RI		R								RIA
Landfill Area Sub-basin	R/W	A	RIA		RA	RIA	A	RIA				RIA	RIA
	UW	A	RI			RA		RIA	A	R			RIA
SWMU 12 Source Area	R/W	A	RIA		RIA	RIA	A	RIA	R	RI		RIA	RIA
	UW	A	R		R	RA		RA					RA
Trench Area Sub-basin	R/W	A	RI		R	RA		RA	A	R		RIA	RIA
	UW	No data available for the period evaluated.											
SWMU 1 Source Area	R/W	A	RI		R	RA		A		R		RIA	RIA
Western Boundary of ANAD	UW	No data available for the period evaluated.											
Off-post													
Offpost Monitoring Wells	R/W	A				A	A	A					
	UW					A			A				
Offpost Residential Wells	UW	No data available for the period evaluated.											
Coldwater Spring	--												A

ANAD = Anniston Army Depot.
ARAR = Applicable or relevant and appropriate requirement.
BEHP = bis(2-ethylhexyl)phthalate
COC = Contaminant of concern.
R/W = Residuum/weathered bedrock
SWMU = Solid waste management unit
TCE = Trichloroethene
UW = Unweathered bedrock
A= the maximum detection exceeded the one of the ARARs: [federal and Alabama maximum contaminant levels (MCLs), non-zero federal maximum contaminant level goals (MCLG), and federal and Alabama secondary MCLs (SMCLs)]. That is, the maximum detection exceeded the lowest of the ARARs.
I = the risks for Industrial workers exceeded the target risk levels
R = the risks for residents exceeded the target risk levels
Examples: RIA = the risks for both the industrial workers and residents exceeded the target risk levels; the maximum detection exceeded one of the ARARs
= the target risk levels were exceeded for both residents and industrial workers
The ARAR screening criterion is the lowest of the ARARs:
(1) Aluminum: Alabama SMCL of 200 µg/L
(2) Arsenic: federal MCL of 10 µg/L
(3) Beryllium: federal MCL of 4 µg/L
(4) Chromium: federal MCL of 100 µg/L
(5) Iron: Alabama SMCL of 300 µg/L
(6) Lead: Alabama MCL of 15 µg/L
(7) Manganese: Alabama SMCL of 50 µg/L
(8) BEHP: federal MCL of 6 µg/L
(9) Chloroform: federal MCL for Trihalomethanes of 80 µg/L
(10) Carbon Tetrachloride: federal MCL of 5 µg/L
(11) Methylene Chloride: federal MCL of 5 µg/L
(12) TCE: federal MCL of 5 µg/L

2.7.2 Summary of Ecological Risk

The preliminary ecological risk evaluation for Dry Creek surface water and sediment indicated that two metals (cadmium and lead) and 11 polynuclear aromatic hydrocarbons (PAHs) in the creek sediment likely posed risk to sediment-dwelling biota. Potential risk may also be posed to aquatic biota by zinc in the surface water (SAIC, 1998a). However, follow-on toxicity tests for sediment and surface water indicated no adverse impacts on the survival or growth of the biota compared to background media (SAIC, 2001).

Pygmy sculpin (*Cottus paulus*), an ecological receptor at CWS, is currently being investigated. The pygmy sculpin is listed as a threatened species under the Endangered Species Act (ESA). The ongoing pygmy sculpin investigation is to determine whether there is unacceptable risk to the pygmy sculpin from exposure to the TCE in CWS. Upon completion of this investigation, if the risk pathway for pygmy sculpin is identified, it will be addressed in an addendum to the OU-1 FFS (Tetra Tech, 2012b), and an Explanation of Significant Differences or Amendment (as appropriate) to this IROD Amendment will be issued.

2.7.3 Basis for Action

Unacceptable human health risks or ARAR exceedances were identified for eight chemicals in groundwater at the SIA under hypothetical residential scenario, including TCE, BEHP, methylene chloride, PCE, arsenic, chromium, lead, and manganese. Because unacceptable risks or ARAR exceedances were identified, the response action selected in this IROD Amendment is intended by the Army to protect public health and welfare, and the environment from actual or threatened releases of hazardous substances into the environment. Note that risks associated with the Pygmy Sculpin in Coldwater Spring are currently being evaluated and will be addressed later as an amendment to the IROD or ESD (Section 2.7.2), as appropriate. Data collected during implementation of the interim remedy will be used to improve site remedial decision making so that ultimately a final ROD can be completed for this site.

2.8 Remedial Action Objectives

RAOs are medium-specific goals that help to define the objective of the remedial actions to protect human health and the environment. RAOs can specify the COCs, potential exposure routes and receptors, and acceptable concentrations (i.e., cleanup levels) for a site and provide a general description of what the cleanup will accomplish. RAOs typically serve as the design basis for the remedial alternatives described in Section 2.9. The RAOs for OU-1 are as follows (Tetra Tech, 2012b):

RAO No. 1: Prevent exposure of current and future residents and industrial workers to groundwater containing concentrations of COCs greater than MCLs[1] (Table 2-6 lists the cleanup levels for each COC).

RAO No. 2: Minimize further migration of the contaminant plume;

RAO No. 3: Minimize further migration of contaminants from source areas[2];

RAO No. 4: Return usable groundwater to its beneficial uses wherever practicable[3].

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[1] In the absence of MCL for a specific COC, a risk-based criterion should be used.
[2] Source areas are defined as areas with TCE concentrations greater than 10 mg/L that contain principal threat wastes (per the discussion of Tier 1 Partnering Team Meeting in December 2011).
[3] NCP 300.430(a)(1)(iii)(F)

RAO No. 5: Prevent exposure to ecological receptors (Pygmy Sculpin) above the No Observable Effect Limit (NOEL) for TCE[4].

Table 2-6 Cleanup Levels of COCs

Chemical of Concern	Cleanup Levels (μg/L)	Basis
Arsenic	10	Federal MCL
Bis(2-ethylhexyl) phthalate	6	Federal MCL
Chromium (Total)	100	Federal MCL
cis-1,2-Dichlorethene[(1)]	70	Federal MCL
Lead	15	AL MCL
Manganese	50	Federal SMCL
Methylene chloride	5	Federal MCL
Tetrachloroethene	5	Federal MCL
Trichloroethene	5	Federal MCL
Vinyl chloride[(1)]	2	Federal MCL

Notes:

MCL - Maximum Contaminant Level.

SMCL – Secondary Maximum Contaminant Level.

[(1)] These compounds were not identified as COCs; however, they are degradation products of TCE and should be monitored with TCE.

The LUC performance objectives are as follows:

- Prevent access to or use of groundwater until clean-up levels are met.
- Maintain the integrity of any current for future remedial or monitoring system during its operation, such as monitoring wells and associated piping and treatment systems.

2.9 DESCRIPTION OF ALTERNATIVES

To address potential unacceptable human health risks and ARAR exceedances associated with groundwater at the SIA, technologies and process options potentially applicable to the remedial alternatives for OU-1 were evaluated in the FFS (Tetra Tech, 2012b). A preliminary screening and detailed screening of technologies and process options yielded technologies and process options retained for the development of groundwater remedial alternatives. The retained technologies and process options are summarized in Table 2-7 under corresponding general response actions (GRAs).

[4] The development of the NOEL for TCE has not been completed.

Table 2-7 Retained Technologies and Process Options		
General Response Action	**Technology**	**Process Options**
No Action	None	Not applicable
Limited Action	LUCs	Groundwater use restrictions, construction restrictions
	Monitoring	Sampling and analysis
POUT	Physical	Air stripping
Removal	Groundwater extraction	Extraction wells
	Excavation	Saturated soil excavation
In-Situ Treatment	Biological	Enhanced bioremediation with an electron-donor compound
	Chemical	Chemical oxidation
	Thermal	Thermal treatment
Ex-Situ Treatment	Physical	Filtration
		Air stripping
		Liquid-phase granular activated carbon (GAC) adsorption
		Vapor-phase GAC adsorption
		Gravity separation
	Chemical	Coagulation
		Neutralization/pH adjustment
		Chemical precipitation
Disposal	Discharge	Direct surface water discharge

The technologies and process options retained were assembled into an adequate variety of potential remedial alternatives for each of the four source areas at the SIA. These preliminary alternatives were then evaluated with respect to the short and long-term aspects of the three broad evaluation criteria specified in the EPA guidance for conducting RIs/FSs (EPA, 1988), including effectiveness, implementability, and cost. The purpose of this screening evaluation for potential remedial alternatives was to reduce the number of alternatives that would undergo a more thorough and extensive analysis. The potential remedial alternatives and the screening results are summarized in Table 2-8.

TABLE 2-8

SUMMARY OF ALTERNATIVE SCREENING FOR DETAILED ANALYSIS
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
PAGE 1 OF 6

Source Area	Alternative	Advantages	Disadvantages	Screening Decisions for Detailed Analysis
Landfill	Alternative 1: No action	• Strong evidence of reductive dechlorination effectiveness • Mass reduction mechanism provided by reductive dechlorination processes • Relatively inexpensive • Low carbon footprint	• Limited mass reduction ability. • Little impact on site longevity (i.e., cleanup timeframe is likely very long)	**Retained.** This alternative is retained as per CERCLA requirement.
	Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs	• Reduction in source mass loadings (to the plume) provided by eGWIS • Proven effectiveness of POUT at CWS • Strong evidence of reductive dechlorination effectiveness	• Difficult to predict the necessary operation duration of the eGWIS in advance • Long-term system reliability commitment required for both POUT at CWS and eGWIS • Significant cleanup timeframe reduction unlikely due to limited mass reduction rate of a P&T system (i.e., the eGWIS) • Medium carbon footprint	**Retained.** The data suggests that even the current (deficient) GWIS is capable of capturing a sizable fraction of the overall mass flux from the source zones. The enhanced GWIS (eGWIS) is expected to be effective in targeting the mobile source mass and reducing mass loadings from the source zones, thus reducing the contaminant concentrations in the source zones and the downgradient plumes, which would reduce the contaminant discharge to the CWS.
	Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs	• All advantages listed for Alternative 2, plus • Additional source mass reduction in the short term (by aggressive bioremediation) • Potential reduction in the eGIWS operation duration provided by bioremediation	• All disadvantages listed for Alternative 2, plus • Difficult to predict and measure the effectiveness of bioremediation due to the level of complexity of the site • Significant cleanup timeframe reduction unlikely even with aggressive bioremediation due to the complexity of the site (e.g., large quantities of DNAPL TCE and complex geology/hudrogeology) • Treatment effectiveness in the bedrock limited due to matrix back diffusion	**Retained.** Aggressive bioremediation is included as an add-on component for partial source mass removal. Although immediate impact of bioremediation on plume concentrations may not be measured in real time, it would contribute to the contaminant concentration reduction in the long term. This alternative provides additional benefits of (partial) source mass removal on top of that from the eGWIS and reductive dechlorination .
	Alternative 4: POUT at CWS, eGWIS, Long-term Bioremediation, LTM, and LUCs	• Similar advantages as Alternative 3 except additional source mass reduction may be theoretically achieved via long term bioremediation	• Same disadvantages as Alternative 3, plus • Effectiveness issues related to long-term operation of bioremediation and excessive substrate delivered, including biofouling, reduction in hydraulic conductivity, outgrowth of competing microorganisms, and toxicity issues, • Long-term system reliability of the bioremediation system • Additional O&M cost associated with long-term bioremediation	Eliminated. Long-term operation of the recirculation/groundwater amending system theoretically may treat more contaminants; however, practically long-term operation will be counter-productive due to excessive substrate delivering and the resulted issues such as biofouling, reduction in hydraulic conductivity, outgrowth of competing microorganisms, and toxicity issues, Long-term operation will require extensive maintenance and commitment of system reliability, which makes the implementability of this alternative questionable. Long-term bioremediation also requires additional O&M cost.

TABLE 2-8

**SUMMARY OF ALTERNATIVE SCREENING FOR DETAILED ANALYSIS
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Source Area	Alternative	Advantages	Disadvantages	Screening Decisions for Detailed Analysis
Landfill (Cont.)	Alternative 5: POUT at CWS, eGWIS, Aggressive ISCO, LTM, and LUCs	• All advantages listed for Alternative 2, plus • Additional source mass reduction in the short-term (by aggressive ISCO) • Potential reduction in the eGIWS operation duration provided by ISCO	• All disadvantages listed for Alternative 2, plus • Difficult to predict and measure the effectiveness of ISCO • Uncertain effectiveness due to the uncertainty in contaminant mass estimation • Significant cleanup timeframe reduction unlikely even with aggressive ISCO • Treatment effectiveness in the bedrock limited due to matrix back diffusion • Unfavorable historical ISCO treatment results indicating technical challenges • Additional risks such as unintentional metal mobilization, potential in reduction of aquifer permeability, and potential in impeding DNAPL dissolution • Potential adverse impact of ISCO on geochemical conditions and microorganisms for reductive dechlorination • Adjustment in pH (which may be required using various types of ISCO and the) may potentially resultant progressive dissolution of carbonate bedrock. This may or may not result in geotechnical concerns at Anniston. • Potential for the injected ISCO reagents and mobilized metals migrating off site towards CWS	Eliminated. Overall effectiveness of this alternative maybe similar to Alternative 3. However, there will likely be additional risks associated with the ISCO reagents.
	Alternative 6: POUT at CWS, eGWIS, Long Term ISCO, LTM, and LUCs	• Similar advantages as Alternative 5 except additional source mass reduction may be theoretically achieved in the long-term (via long term ISCO)	• Same disadvantages as Alternative 5, plus • More additional risks associated with long-term operation • Long-term system reliability of the ISCO system • Additional O&M cost associated with long-term ISCO	Eliminated. Same rationale as for Alternative 5, plus concerns regarding more additional risks, long-term system reliability, and additional O&M cost.

TABLE 2-8

**SUMMARY OF ALTERNATIVE SCREENING FOR DETAILED ANALYSIS
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
PAGE 3 OF 6**

Source Area	Alternative	Advantages	Disadvantages	Screening Decisions for Detailed Analysis
Landfill (Cont.)	Alternative 7: POUT at CWS, eGWIS, Limited Excavation, LTM, and LUCs	• All advantages listed for Alternative 2, plus • Potential large quantities of mass removal via excavation in the short-term • The DNAPL dissolution process may be accelerated due to the removal of a large portion of the low permeable residuum (currently the low flow through the residuum may limit the dissolution process)	• All disadvantages listed for Alternative 2, plus • While partially excavating the residuum is practical, it will not achieve RAO No. 3 because a large portion of the contaminant mass would still remain in the unexcavated portion of the saturated residuum • If only partially excavating the residuum and/or weathered bedrock excavation of the low permeable clayey residuum will likely mobilize the currently trapped source mass in the residuum due to enhanced infiltration through the backfilled materials with higher permeability • If only partially excavating the residuum and/or weathered bedrock mass discharge emanating from the source zones will likely increase due to the increase of the infiltration resulted from the removal of the low permeable residuum • Fully excavating the residuum and weathered bedrock is not practical because 1) sheet piling method cannot be used; 2) the use of sloped wall will require excavating and disposing several times more of the intended amount of materials from areas outside of the source zone; 3) the requirements of dewatering and IDW treatment are more than those for the Building 114 (240 gpm); 4) the capital cost will be very high, if not impractical	Eliminated While practical, partial excavation of the residuum will not meet RAO No. 3 and may mobilize the currently immobile source mass and increase infiltration and mass flux emanating from the residuum, which may worsen the off-site migration of the contaminants. Fully excavating the residuum and weathered bedrock is not practical as discussed.
Trench	Alternative 1: No action	• Mass reduction mechanism provided by NA processes • Relatively inexpensive • Low carbon footprint	• Limited mass reduction ability; • Little impact on site longevity (i.e., cleanup timeframe is likely very long)	**Retained.** This alternative is retained as per CERCLA requirement.
	Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs	• Reduction in source mass loadings (to the plume) provided by eGWIS • Proven effectiveness of POUT at CWS • Strong evidence of reductive dechlorination effectiveness	• Difficult to predict the necessary operation duration of the eGWIS in advance • Long-term system reliability commitment required for both POUT at CWS and eGWIS • Significant cleanup timeframe reduction unlikely due to limited mass reduction rate of a P&T system (i.e., the eGWIS) • Medium carbon footprint	**Retained.** The data suggests that even the current (deficient) GWIS is capable of capturing a sizable fraction of the overall mass flux from the source zones. The enhanced GWIS (eGWIS) is expected to be effective in targeting the mobile source mass and reducing mass loadings from the source zones, thus reducing the contaminant concentrations in the source zones and the downgradient plumes, which would reduce the contaminant discharge to the CWS.
	Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs	• All advantages listed for Alternative 2, plus • Additional source mass reduction in the short term (by aggressive bioremediation) • Potential reduction in the eGIWS operation duration provided by bioremediation	• All disadvantages listed for Alternative 2, plus • Difficult to predict and measure the effectiveness of bioremediation due to the level of complexity of the site • Significant cleanup timeframe reduction unlikely even with aggressive bioremediation due to the complexity of the site (e.g., large quantities of DNAPL TCE and complex geology/hudrogeology) • Treatment effectiveness in the bedrocks limited due to matrix back diffusion	**Retained.** Aggressive bioremediation is included as an add-on component for partial source mass removal. Although immediate impact of bioremediation on plume concentrations may not be measured in real time, it would contribute to the contaminant concentration reduction in the long term. This alternative provides additional benefits of (partial) source mass removal on top of that from the eGWIS and reductive dechlorination.

TABLE 2-8

SUMMARY OF ALTERNATIVE SCREENING FOR DETAILED ANALYSIS
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Source Area	Alternative	Advantages	Disadvantages	Screening Decisions for Detailed Analysis
Trench (Cont.)	Alternative 4: POUT at CWS, eGWIS with bioreactor, LTM, and LUCs	• All advantages listed for Alternative 2, plus • The extracted water may be treated in the bioreactor landfill to save O&M costs	• All disadvantages listed for Alternative 2, plus • The SMWU 2 landfill was capped and closed in 1993. Therefore, converting this landfill to a bioreactor is not an effective approach and likely not feasible	Eliminated. The feasibility of using landfill as a bioreactor is in general uncertain and needs further investigation. The use of SWMU 2, a long-closed landfill as bioreactor is not an effective approach and likely not feasible.
	Alternative 5: POUT at CWS, eGWIS, Long Term Bioremediation, LTM and LUCs	• Similar advantages as Alternative 3 except additional source mass reduction may theoretically be achieved via long term bioremediation)	• Same disadvantages as Alternative 3, plus • Effectiveness issues related to long-term operation of bioremediation and excessive substrate delivered, including biofouling, reduction in hydraulic conductivity, outgrowth of competing microorganisms, and toxicity issues • Long-term system reliability of the bioremediation system • Additional O&M cost associated with long-term bioremediation	Eliminated. Long-term operation of the recirculation/groundwater amending system theoretically may treat more contaminants; however, practically long-term operation will be counter-productive due to excessive substrate delivering and the resulted issues such as biofouling, reduction in hydraulic conductivity, outgrowth of competing microorganisms, and toxicity issues, Long-term operation will require extensive maintenance and commitment of system reliability, which makes the implementability of this alternative questionable. Long-term bioremediation also requires additional O&M cost.
Northeast	Alternative 1: No action	• Mass reduction mechanism provided by reductive dechlorination processes • Relatively inexpensive • Low carbon footprint	• Limited mass reduction ability; • Little impact on site longevity (i.e., cleanup timeframe is likely very long)	**Retained.** This alternative is retained per CERCLA requirement.
	Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs	• Reduction in source mass loadings (to the plume) provided by eGWIS • Proven effectiveness of POUT at CWS • Strong evidence of REDUCTIVE DECHLORINATION effectiveness	• Difficult to predict the necessary operation duration of the eGWIS in advance • Long-term system reliability commitment required for both POUT at CWS and eGWIS • Significant cleanup timeframe reduction unlikely due to limited mass reduction rate of a P&T system (i.e., the eGWIS) • Medium carbon footprint	**Retained.** The data suggests that even the current (deficient) GWIS is capable of capturing a sizable fraction of the overall mass flux from the source zones. The enhanced GWIS (eGWIS) is expected to be effective in targeting the mobile source mass and reducing mass loadings from the source zones, thus reducing the contaminant concentrations in the source zones and the downgradient plumes, which would reduce the contaminant discharge to the CWS.
	Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs	• All advantages listed for Alternative 2, plus • Additional source mass reduction in the short term (by aggressive bioremediation) • Potential reduction in the eGIWS operation duration provided by bioremediation	• All disadvantages listed for Alternative 2, plus • Difficult to predict and measure the effectiveness of bioremediation due to the level of complexity of the site • Significant cleanup timeframe reduction unlikely even with aggressive bioremediation due to the complexity of the site (e.g., large quantities of DNAPL TCE and complex geology/hudrogeology) • Treatment effectiveness in the bedrock limited due to matrix back diffusion	**Retained.** Aggressive bioremediation is included as an add-on component for partial source mass removal. Although immediate impact of bioremediation on plume concentrations may not be measured in real time, it would contribute to the contaminant concentration reduction in the long term. This alternative provides additional benefits of (partial) source mass removal on top of that from the eGWIS and reductive dechlorination.
	Alternative 4: POUT at CWS, eGWIS, Long Term Bioremediation, LTM, and LUCs	• Similar advantages as Alternative 3 except additional source mass reduction may be achieved via long term bioremediation	• Same disadvantages as Alternative 3, plus • Effectiveness issues related to long-term operation of bioremediation and excessive substrate delivered, including biofouling, reduction in hydraulic conductivity, outgrowth of competing microorganisms, and toxicity issues, • Long-term system reliability of the bioremediation system • Additional O&M cost associated with long-term bioremediation	Eliminated. Long-term operation of the recirculation/groundwater amending system theoretically may treat more contaminants; however, practically long-term operation will be counter-productive due to excessive substrate delivering and the resulted issues such as biofouling, reduction in hydraulic conductivity, outgrowth of competing microorganisms, and toxicity issues, Long-term operation will require extensive maintenance and commitment of system reliability, which makes the implementability of this alternative questionable. Long-term bioremediation also requires additional O&M cost.

TABLE 2-8

SUMMARY OF ALTERNATIVE SCREENING FOR DETAILED ANALYSIS
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Source Area	Alternative	Advantages	Disadvantages	Screening Decisions for Detailed Analysis
	Alternative 5: POUT at CWS, eGWIS, Thermal Treatment, LTM, and LUCs	• All advantages listed for Alternative 2, plus • Potential large quantities of mass removal via thermal treatment in the short term • Potential enhancement to reductive dechlorination after thermal treatment due to increased temperature	• All disadvantages listed for Alternative 2, plus • Potential of mobilizing trapped contaminant mass • Potential of poor vapor recovery due to high heterogeneity • Potential of contaminating the Dry Creek, which leads to potential off-site migration	Eliminated. This alternative is eliminated due to implementability issues caused by the Dry Creek, which flows across the center of the Northeast Area. The potential risks of uncontrolled contaminants mobilization is another concern.
Northeast (Cont.)	Alternative 6: POUT at CWS, eGWIS, Aggressive ISCO, LTM, and LUCs	• All advantages listed for Alternative 2, plus • Additional source mass reduction in the short-term (by aggressive ISCO) • Potential reduction in the eGIWS operation duration provided by ISCO	• All disadvantages listed for Alternative 2, plus • Difficult to predict and measure the effectiveness of ISCO • Uncertain effectiveness due to the uncertainty in contaminant mass estimation • Significant cleanup timeframe reduction unlikely even with aggressive ISCO • Treatment effectiveness in the bedrock limited due to matrix back diffusion • Unfavorable historical ISCO treatment results indicating technical challenges • Additional risks such as unintentional metal mobilization, potential in reduction of aquifer permeability, and potential in impeding DNAPL dissolution • Potential adverse impact of ISCO on geochemical conditions and microorganisms for reductive dechlorination. • Adjustment in pH (which may be required using various types of ISCO and the) may potentially resultant progressive dissolution of carbonate bedrock. This may or may not result in geotechnical concerns at Anniston. • Potential for the injected ISCO reagents and mobilized metals migrating off site towards CWS	Eliminated. Overall effectiveness of this alternative maybe similar to Alternative 3. However, there will likely be additional risks associated with the ISCO reagents.
	Alternative 7: POUT at CWS, eGWIS, Long Term ISCO, LTM, and LUCs	• Similar advantages as Alternative 6 except additional source mass reduction may be theoretically achieved in the long-term (via long term ISCO)	• Same disadvantages as Alternative 6, plus • More additional risks associated with long-term operation • Long-term system reliability of the ISCO system • Additional O&M cost associated with long-term ISCO	Eliminated. Same rationale as for Alternative 5, plus concerns regarding more additional risks, long-term system reliability, and additional O&M cost.
Industrial	Alternative 1: No action	• Mass reduction mechanism provided by reductive dechlorination processes • Relatively inexpensive • Low carbon footprint	• Limited mass reduction ability; • Little impact on site longevity (i.e., cleanup timeframe is likely very long)	**Retained.** This alternative is retained per CERCLA requirement.
	Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs	• Reduction in source mass loadings (to the plume) provided by eGWIS • Proven effectiveness of POUT at CWS • Strong evidence of reductive dechlorination effectiveness	• Difficult to predict the necessary operation duration of the eGWIS in advance • Long-term system reliability commitment required for both POUT at CWS and eGWIS • Significant cleanup timeframe reduction unlikely due to limited mass reduction rate of a P&T system (i.e., the eGWIS) • Medium carbon footprint	**Retained.** The data suggests that even the current (deficient) GWIS is capable of capturing a sizable fraction of the overall mass flux from the source zones. The enhanced GWIS (eGWIS) is expected to be effective in targeting the mobile source mass and reducing mass loadings from the source zones, thus reducing the contaminant concentrations in the source zones and the downgradient plumes, which would reduce the contaminant discharge to the CWS.

TABLE 2-8

SUMMARY OF ALTERNATIVE SCREENING FOR DETAILED ANALYSIS
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Source Area	Alternative	Advantages	Disadvantages	Screening Decisions for Detailed Analysis
Industrial (cont.)	Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs	• All advantages listed for Alternative 2, plus • Additional source mass reduction in the short term (by aggressive bioremediation) • Potential reduction in the eGIWS operation duration provided by bioremediation	• All disadvantages listed for Alternative 2, plus • Difficult to predict and measure the effectiveness of bioremediation due to the level of complexity of the site • Significant cleanup timeframe reduction unlikely even with aggressive bioremediation due to the complexity of the site (e.g., large quantities of DNAPL TCE and complex geology/hudrogeology) • Treatment effectiveness in the bedrock limited due to matrix back diffusion	Aggressive bioremediation will not be conducted in the Industrial Area due to significant implementability and access limitations. However, if operations in the Industrial Area change and if access can be obtained, aggressive near-term bioremediation will be implemented, as necessary.

As a result, the following alternatives were developed and evaluated in detail for the four source areas:

Landfill Area:

Alternative 1: No action

Alternative 2: POUT at CWS, enhanced groundwater interceptor system (eGWIS), LTM, and LUCs

Alternative 3: POUT at CWS, eGWIS, aggressive bioremediation, LTM, and LUCs

Trench Area:

Alternative 1: No action

Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs

Alternative 3: POUT at CWS, eGWIS, aggressive bioremediation, LTM, and LUCs

Northeast Area:

Alternative 1: No action

Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs

Alternative 3: POUT at CWS, eGWIS, aggressive bioremediation, LTM, and LUCs

Industrial Area:

Alternative 1: No action

Alternative 2[5]: POUT at CWS, eGWIS, LTM, and LUCs

Consistent with the NCP, the no action alternative was evaluated as a baseline for comparison with other alternative during the comparative analysis. Table 2-9 describe the major components and provide estimated costs for each remedial alternative identified for the four source areas.

[5] Currently the ANAD mission limits access to conduct aggressive insitu bioremediation in the Industrial Area. In the event that the mission in the Industrial Area changes and access to this source area is available, this will be re-evaluated for potential implementation of PSMR (aggressive bioremediation).

TABLE 2-9

SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR OU 1
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Source Area	Alternative	Components	Details	Cost
Landfill	Alternative 1: No action	None	No action; five-year reviews would be implemented.	• Capital Cost: $16,000 • 30-year NPW of O&M Cost: $96,000 • Discount rate: 4% • Time frame: 3,400 to over 10,000 years
	Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs	• POUT at CWS - maintenance and potential optimization of the KWTP at CWS • eGWIS – operating an enhanced pump and treat system in the source zone to provide mobile mass extraction focusing on the upper portion of the weathered bedrock to reduce mass discharge from the residuum/upper weather bedrock and minimize further contaminant migration into the unweathered bedrock • LTM – long term monitoring of COC concentrations and collection of information to improve understanding of natural attenuation processes • LUCs – land and groundwater use restrictions within the SIA, fence and signage maintenance, and advisories to potential groundwater users	• POUT at CWS – the current capacity of the six air strippers at the KWTP is sufficient to treat the water from CWS. If the amount of water to be treated or the influent TCE concentration exceeds the capacity upgrade/optimization of the KWTP would be implemented. • eGWIS – one existing and two new extraction wells in the source zone (with TCE concentrations greater than 10 mg/L) would be used. • LTM – long term monitoring of COC concentrations will be conducted. MNA parameters would be included, as needed, in the analyte list, in addition to the COCs. • LUCs – groundwater use restrictions will continue to be applied with the SIA. Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring. The Army would continue to maintain the fence and signage to the facility. Advisories would be issued by the state to provide notice to potential users of the groundwater (e.g., private well owners) of the risk associated with groundwater use.	• Capital Cost: $1,480,000 • 30-year NPW of O&M Cost: $2,140,000 • Discount rate: 4% • Time frame: 3,400 to over 10,000 years
	Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs	• POUT at CWS - maintenance and potential optimization of the KWTP at CWS • eGWIS – operating an enhanced pump and treat system in the source zone to provide mobile mass extraction focusing on the upper portion of the weathered bedrock to reduce mass discharge from the residuum/upper weather bedrock and minimize further contaminant migration into the unweathered bedrock • Aggressive Bioremediation – supplemental partial source mass removal in the source zone via injecting electron donors, nutrients, and possibly microbial cultures into the subsurface • LTM – long term monitoring of COC concentrations and collection of information to improve understanding of natural attenuation processes • LUCs – land and groundwater use restrictions within the SIA, fence and signage maintenance, and advisories to potential groundwater users	• POUT at CWS – the current capacity of the six air strippers at the KWTP is sufficient to treat the water from CWS. If the amount of water to be treated or the influent TCE concentration exceeds the capacity upgrade/optimization of the KWTP would be implemented. • eGWIS – one existing and two new extraction wells in the source zone (with TCE concentrations greater than 10 mg/L) would be used. • Aggressive Bioremediation – an injection system would be used to inject amendments to the saturated residuum in the source zone and groundwater would be extracted via the eGWIS. • LTM – long term monitoring of COC concentrations will be conducted. MNA parameters would be included, as needed, in the analyte list, in addition to the COCs. • LUCs – groundwater use restrictions will continue to be applied with the SIA. Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring. The Army would continue to maintain the fence and signage to the facility. Advisories would be issued by the state to provide notice to potential users of the groundwater (e.g., private well owners) of the risk associated with groundwater use.	• Capital Cost: $2,340,000 • 30-year NPW of O&M Cost: $2,390,000 • Discount rate: 4% • Time frame: 3,400 to 7900 years

**The cost and time of remediation in this table are based on predictive modeling which is inherently uncertain. The model results included significant uncertainty and should only be used for comparison of alternative. These values should not be mistaken as absolute or well defined values. Please see Appendix A for additional explanation.*

TABLE 2-9

SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR OU 1
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Source Area	Alternative	Components	Details	Cost
Trench	Alternative 1: No action	None	No action; five-year reviews would be implemented.	• Capital Cost: $16,000 • 30-year NPW of O&M Cost: $96,000 • Discount rate: 4% • Time frame: 180 to 1450 years
	Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs	• POUT at CWS - maintenance and potential optimization of the KWTP at CWS • eGWIS – operating an enhanced pump and treat system in the source zone to provide mobile mass extraction focusing on the upper portion of the weathered bedrock to reduce mass discharge from the residuum/upper weather bedrock and minimize further contaminant migration into the unweathered bedrock • LTM – long term monitoring of COC concentrations and collection of information to improve understanding of natural attenuation processes • LUCs – land and groundwater use restrictions within the SIA, fence and signage maintenance, and advisories to potential groundwater users	• POUT at CWS – the current capacity of the six air strippers at the KWTP is sufficient to treat the water from CWS. If the amount of water to be treated or the influent TCE concentration exceeds the capacity upgrade/optimization of the KWTP would be implemented. • eGWIS – one existing and two new extraction wells in the source zone (with TCE concentrations greater than 10 mg/L) would be used. • LTM – long term monitoring of COC concentrations will be conducted. MNA parameters would be included, as needed, in the analyte list, in addition to the COCs. • LUCs – groundwater use restrictions will continue to be applied with the SIA. Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring. The Army would continue to maintain the fence and signage to the facility. Advisories would be issued by the state to provide notice to potential users of the groundwater (e.g., private well owners) of the risk associated with groundwater use.	• Capital Cost: $1,720,000 • 30-year NPW of O&M Cost: $2,590,000 • Discount rate: 4% • Time frame: 160 to 1420 years
	Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs	• POUT at CWS - maintenance and potential optimization of the KWTP at CWS • eGWIS – operating an enhanced pump and treat system in the source zone to provide mobile mass extraction focusing on the upper portion of the weathered bedrock to reduce mass discharge from the residuum/upper weather bedrock and minimize further contaminant migration into the unweathered bedrock • Aggressive Bioremediation – supplemental partial source mass removal in the source zone via injecting electron donors, nutrients, and possibly microbial cultures into the subsurface • LTM – long term monitoring of COC concentrations and collection of information to improve understanding of natural attenuation processes • LUCs – land and groundwater use restrictions within the SIA, fence and signage maintenance, and advisories to potential groundwater users	• POUT at CWS – the current capacity of the six air strippers at the KWTP is sufficient to treat the water from CWS. If the amount of water to be treated or the influent TCE concentration exceeds the capacity upgrade/optimization of the KWTP would be implemented. • eGWIS – two existing and two new extraction wells in the source zone (with TCE concentrations greater than 10 mg/L) would be used. • Aggressive Bioremediation – an injection system would be used to inject amendments to the saturated residuum in the source zone and groundwater would be extracted via the eGWIS. • LTM – long term monitoring of COC concentrations will be conducted. MNA parameters would be included, as needed, in the analyte list, in addition to the COCs. • LUCs – groundwater use restrictions will continue to be applied with the SIA. Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring. The Army would continue to maintain the fence and signage to the facility. Advisories would be issued by the state to provide notice to potential users of the groundwater (e.g., private well owners) of the risk associated with groundwater use.	• Capital Cost: $2,790,000 • 30-year NPW of O&M Cost: $3,000,000 • Discount rate: 4% • Time frame: 160 to 1415 years

**The cost and time of remediation in this table are based on predictive modeling which is inherently uncertain. The model results included significant uncertainty and should only be used for comparison of alternative. These values should not be mistaken as absolute or well defined values. Please see Appendix A for additional explanation.*

TABLE 2-9

SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR OU 1
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Source Area	Alternative	Components	Details	Cost
Northeast	Alternative 1: No action	None	No action; five-year reviews would be implemented.	• Capital Cost: $16,000 • 30-year NPW of O&M Cost: $96,000 • Discount rate: 4% • Time frame: 1230 to 1650 years
	Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs	• POUT at CWS - maintenance and potential optimization of the KWTP at CWS • eGWIS – operating an enhanced pump and treat system in the source zone to provide mobile mass extraction focusing on the upper portion of the weathered bedrock to reduce mass discharge from the residuum/upper weather bedrock and minimize further contaminant migration into the unweathered bedrock • LTM – long term monitoring of COC concentrations and collection of information to improve understanding of natural attenuation processes • LUCs – land and groundwater use restrictions within the SIA, fence and signage maintenance, and advisories to potential groundwater users	• POUT at CWS – the current capacity of the six air strippers at the KWTP is sufficient to treat the water from CWS. If the amount of water to be treated or the influent TCE concentration exceeds the capacity upgrade/optimization of the KWTP would be implemented. • eGWIS – one existing and two new extraction wells in the source zone (with TCE concentrations greater than 10 mg/L) would be used. • LTM – long term monitoring of COC concentrations will be conducted. MNA parameters would be included, as needed, in the analyte list, in addition to the COCs. • LUCs – groundwater use restrictions will continue to be applied with the SIA. Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring. The Army would continue to maintain the fence and signage to the facility. Advisories would be issued by the state to provide notice to potential users of the groundwater (e.g., private well owners) of the risk associated with groundwater use.	• Capital Cost: $1,930,000 • 30-year NPW of O&M Cost: $3,160,000 • Discount rate: 4% • Time frame: 1100 to 1600 years
	Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs	• POUT at CWS - maintenance and potential optimization of the KWTP at CWS • eGWIS – operating an enhanced pump and treat system in the source zone to provide mobile mass extraction focusing on the upper portion of the weathered bedrock to reduce mass discharge from the residuum/upper weather bedrock and minimize further contaminant migration into the unweathered bedrock • Aggressive Bioremediation – supplemental partial source mass removal in the source zone via injecting electron donors, nutrients, and possibly microbial cultures into the subsurface • LTM – long term monitoring of COC concentrations and collection of information to improve understanding of natural attenuation processes • LUCs – land and groundwater use restrictions within the SIA, fence and signage maintenance, and advisories to potential groundwater users	• POUT at CWS – the current capacity of the six air strippers at the KWTP is sufficient to treat the water from CWS. If the amount of water to be treated or the influent TCE concentration exceeds the capacity upgrade/optimization of the KWTP would be implemented. • eGWIS – one existing and two new extraction wells in the source zone (with TCE concentrations greater than 10 mg/L) would be used. • Aggressive Bioremediation – an injection system would be used to inject amendments to the saturated residuum in the source zone and groundwater would be extracted via the eGWIS. • LTM – long term monitoring of COC concentrations will be conducted. MNA parameters would be included, as needed, in the analyte list, in addition to the COCs. • LUCs – groundwater use restrictions will continue to be applied with the SIA. Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring. The Army would continue to maintain the fence and signage to the facility. Advisories would be issued by the state to provide notice to potential users of the groundwater (e.g., private well owners) of the risk associated with groundwater use.	• Capital Cost: $3,180,000 • 30-year NPW of O&M Cost: $3,630,000 • Discount rate: 4% • Time frame: 830 to 1530 years

**The cost and time of remediation in this table are based on predictive modeling which is inherently uncertain. The model results included significant uncertainty and should only be used for comparison of alternative. These values should not be mistaken as absolute or well defined values. Please see Appendix A for additional explanation.*

TABLE 2-9

SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED FOR OU 1
IROD AMENDMENT
OPERABLE UNIT 1
ANNISTON ARMY DEPOT, ANNISTON, ALABAMA
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Source Area	Alternative	Components	Details	Cost
Industrial	Alternative 1: No action	None	No action; five-year reviews would be implemented.	• Capital Cost: $16,000 • 30-year NPW of O&M Cost: $96,000 • Discount rate: 4% • Time frame: 990 to 2300 years
	Alternative 2: POUT at CWS, eGWIS, LTM, and LUCs	• POUT at CWS - maintenance and potential optimization of the KWTP at CWS • eGWIS – operating an enhanced pump and treat system in the source zone to provide mobile mass extraction focusing on the upper portion of the weathered bedrock to reduce mass discharge from the residuum/upper weather bedrock and minimize further contaminant migration into the unweathered bedrock • LTM – long term monitoring of COC concentrations and collection of information to improve understanding of natural attenuation processes • LUCs – land and groundwater use restrictions within the SIA, fence and signage maintenance, and advisories to potential groundwater users	• POUT at CWS – the current capacity of the six air strippers at the KWTP is sufficient to treat the water from CWS. If the amount of water to be treated or the influent TCE concentration exceeds the capacity upgrade/optimization of the KWTP would be implemented. • eGWIS – four new extraction wells in the source zone (with TCE concentrations greater than 10 mg/L) would be used. No existing extraction wells will be used. • LTM – long term monitoring of COC concentrations will be conducted. MNA parameters would be included, as needed, in the analyte list, in addition to the COCs. • LUCs – groundwater use restrictions will continue to be applied with the SIA. Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring. The Army would continue to maintain the fence and signage to the facility. Advisories would be issued by the state to provide notice to potential users of the groundwater (e.g., private well owners) of the risk associated with groundwater use.	• Capital Cost: $2,180,000 • 30-year NPW of O&M Cost: $3,500,000 • Discount rate: 4% • Time frame: 950 to 2250 years
	Alternative 3: POUT at CWS, eGWIS, Aggressive Bioremediation, LTM, and LUCs	• POUT at CWS - maintenance and potential optimization of the KWTP at CWS • eGWIS – operating an enhanced pump and treat system in the source zone to provide mobile mass extraction focusing on the upper portion of the weathered bedrock to reduce mass discharge from the residuum/upper weather bedrock and minimize further contaminant migration into the unweathered bedrock • Aggressive Bioremediation – supplemental partial source mass removal in the source zone via injecting electron donors, nutrients, and possibly microbial cultures into the subsurface • LTM – long term monitoring of COC concentrations and collection of information to improve understanding of natural attenuation processes • LUCs – land and groundwater use restrictions within the SIA, fence and signage maintenance, and advisories to potential groundwater users	• POUT at CWS – the current capacity of the six air strippers at the KWTP is sufficient to treat the water from CWS. If the amount of water to be treated or the influent TCE concentration exceeds the capacity upgrade/optimization of the KWTP would be implemented. • eGWIS – four new extraction wells in the source zone (with TCE concentrations greater than 10 mg/L) would be used. No existing extraction wells will be used. • Aggressive Bioremediation – an injection system would be used to inject amendments to the saturated residuum in the source zone and groundwater would be extracted via the eGWIS. • LTM – long term monitoring of COC concentrations will be conducted. MNA parameters would be included, as needed, in the analyte list, in addition to the COCs. • LUCs – groundwater use restrictions will continue to be applied with the SIA. Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring. The Army would continue to maintain the fence and signage to the facility. Advisories would be issued by the state to provide notice to potential users of the groundwater (e.g., private well owners) of the risk associated with groundwater use.	Aggressive bioremediation will not be conducted in the Industrial Area due to significant implementability and access limitations. However, if operations in the Industrial Area change and if access can be obtained, aggressive near-term bioremediation will be implemented, as necessary.

**The cost and time of remediation in this table are based on predictive modeling which is inherently uncertain. The model results included significant uncertainty and should only be used for comparison of alternative. These values should not be mistaken as absolute or well defined values. Please see Appendix A for additional explanation.*

2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

Tables 2-10 through 2-13 along with subsequent text in this section summarize the comparison of the OU-1 remedial alternatives to the nine CERCLA evaluation criteria, which are categorized as threshold, primary balancing, and modifying, and are outlined in the NCP at 40 Code of Federal Regulations (CFR) 300.430(e)(9)(iii). Further information on the detailed comparison of remedial alternatives is presented in Table 2-9 in the FFS (Tetra Tech, 2012b).

TABLE 2-10: SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES FOR THE LANDFILL AREA

CERCLA Criterion	ALTERNATIVE 1: No Action	ALTERNATIVE 2: POUT, eGWIS, LTM, LUCs	ALTERNATIVE 3: POUT, eGWIS, aggressive bioremediation, LTM, LUCs
Threshold Criteria			
Overall Protection of Human Health and the Environment	○	●	●
Compliance with ARARs	○	●	●
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	○	⦿	●
Reduction of Toxicity, Mobility, and Volume through Treatment	○	⦿	●
Short-Term Effectiveness	N/A	●	●
Implementability	N/A	●	●
Total Cost[6] (Present Net Worth)	$96,000	$3,620,000	$4,730,000
Modifying Criteria			
State Acceptance	N/A	⦿	●
Community Acceptance[7]	N/A	⦿	⦿
● – Good or Compliance; ⦿ – Average or Partial Compliance; ○ – Poor or No Compliance; N/A – Not applicable			

[6] The cost and time of remediation in this table are based on predictive modeling which is inherently uncertain. The model results included significant uncertainty and should only be used for comparison of alternative. These values should not be mistaken as absolute or well defined values. Please see Appendix A for additional explanation.
[7] The community noted concerns about the cost-benefit of the remedy as discussed in Section 3.

TABLE 2-11: SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES FOR THE TRENCH AREA

CERCLA Criterion	ALTERNATIVE 1: No Action	ALTERNATIVE 2: POUT, eGWIS, LTM, LUCs	ALTERNATIVE 3: POUT, eGWIS, aggressive bioremediation, LTM, LUCs
Threshold Criteria			
Overall Protection of Human Health and the Environment	○	●	●
Compliance with ARARs	○	●	●
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	○	⊙	●
Reduction of Toxicity, Mobility, and Volume through Treatment	○	⊙	●
Short-Term Effectiveness	N/A	●	●
Implementability	N/A	●	●
Total Cost[8] (30-Year Present Net Worth)	$96,000	$4,310,000	$5,790,000
Modifying Criteria			
State Acceptance	N/A	⊙	●
Community Acceptance[9]	N/A	⊙	⊙
● – Good or Compliance; ⊙ – Average or Partial Compliance; ○ – Poor or No Compliance; N/A – Not applicable			

[8] The cost and time of remediation in this table are based on predictive modeling which is inherently uncertain. The model results included significant uncertainty and should only be used for comparison of alternative. These values should not be mistaken as absolute or well defined values. Please see Appendix A for additional explanation.
[9] The community noted concerns about the cost-benefit of the remedy as discussed in Section 3.

Table 2-12: Summary of Comparative Analysis of Alternatives for the Northeast Area			
CERCLA Criterion	**Alternative 1:** No Action	**Alternative 2:** POUT, eGWIS, LTM, LUCs	**Alternative 3:** POUT, eGWIS, aggressive bioremediation, LTM, LUCs
Threshold Criteria			
Overall Protection of Human Health and the Environment	○	●	●
Compliance with ARARs	○	●	●
Primary Balancing Criteria			
Long-Term Effectiveness and Permanence	○	⊙	●
Reduction of Toxicity, Mobility, and Volume through Treatment	○	⊙	●
Short-Term Effectiveness	N/A	●	●
Implementability	N/A	●	●
Total Cost[10] (30-Year Present Net Worth)	$96,000	$5,090,000	$6,810,000
Modifying Criteria			
State Acceptance	N/A	⊙	●
Community Acceptance[11]	N/A	⊙	⊙
● – Good or Compliance; ⊙ – Average or Partial Compliance; ○ – Poor or No Compliance; N/A – Not applicable			

[10] The cost and time of remediation in this table are based on predictive modeling which is inherently uncertain. The model results included significant uncertainty and should only be used for comparison of alternative. These values should not be mistaken as absolute or well defined values. Please see Appendix A for additional explanation.
[11] The community noted concerns about the cost-benefit of the remedy as discussed in Section 3.

TABLE 2-13: SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES FOR THE INDUSTRIAL AREA		
CERCLA Criterion	**ALTERNATIVE 1:** No Action	**ALTERNATIVE 2:** POUT, eGWIS, LTM, LUCs
Threshold Criteria		
Overall Protection of Human Health and the Environment	○	●
Compliance with ARARs	○	●
Primary Balancing Criteria		
Long-Term Effectiveness and Permanence	○	⦿
Reduction of Toxicity, Mobility, and Volume through Treatment	○	⦿
Short-Term Effectiveness	N/A	●
Implementability	N/A	●
Total Cost[12] (30-Year Present Net Worth)	$96,000	$5,680,000
Modifying Criteria		
State Acceptance	N/A	●
Community Acceptance[13]	N/A	⦿
● – Good or Compliance; ⦿ – Average or Partial Compliance; ○ – Poor or No Compliance; N/A – Not applicable		

[12] The cost and time of remediation in this table are based on predictive modeling which is inherently uncertain. The model results included significant uncertainty and should only be used for comparison of alternative. These values should not be mistaken as absolute or well defined values. Please see Appendix A for additional explanation.
[13] The community noted concerns about the cost-benefit of the remedy as discussed in Section 3.

Threshold Criteria

Overall Protection of Human Health and the Environment. The No Action alternative (Alternative 1 for all four source areas) would not achieve the RAOs and therefore would not protect human health or the environment.

All of the other alternatives (Alternative 2 for all four source areas and Alternative 3 for the Landfill Area, Trench Area, and Northeast Area) would provide protection of human health and the environment to the same general degree, as a result of the same components of LUCs, POUT, and LTM in these alternatives. The use of LUCs would protect the on-site and off-site users from exposure to the contaminated groundwater. The use of POUT at CWS would ensure safe drinking water supply to these users. More specifically, to maintain an effluent concentration less than the drinking water standard (5 µg/L for TCE) in water produced from the KWTP, the influent concentration of TCE in CWS to the air strippers cannot exceed 400 µg/L (Tetra Tech, 2012) with the current system. The use of LTM would track the contaminant concentrations over time and evaluate the effectiveness of natural attenuation. Natural attenuation would eventually reduce contaminant concentrations and return usable groundwater to its beneficial uses wherever practicable.

Alternative 3s for the Landfill Area, Trench Area, and Northeast Area differ from Alternative 2s for these areas in that a component of aggressive bioremediation is added to the components in the Alternative 2s. Because aggressive bioremediation would remove more contaminant mass from the source zones in the short term, it may contribute to reduction of contamination at CWS. Aggressive bioremediation is a proven technology to reduce contaminant mass and concentrations. However, it is not certain what the impact of implementing aggressive bioremediation in the source areas will have on contaminant concentrations at CWS which is approximately 1.6 miles downgradient. Peer-reviewed literature (EPA, 2003) and industry experience at DNAPL sites with similar levels of complexity show that partial source mass removal may not be directly correlated with immediate reductions in downgradient concentrations (i.e., measurable changes in concentrations in months or several years). More specifically, the interconnection between the source and CWS via weathered and fractured bedrock media and the fate and transport is likely to result in a negligible impact on CWS in the short term. Moreover, based upon peer reviewed literature and modeling conducted, short term (5 years) or even long term (10+ years) partial source mass removal implementation is not anticipated to have significant impact on downgradient concentrations in CWS. Short or long term partial source mass removal is also not expected to significantly change the overall durations of remediation based upon predictive modeling. Therefore Alternative 3s may not provide better protection as compared to Alternative 2s.

Compliance with ARARs. Alternative 2s and 3s for all four source areas would all eventually comply with cleanup levels through a combination of eGWIS, partial source mass removal, and LTM. Alternatives that include partial source mass removal (Alternative 3s) may reach cleanup levels slightly faster compared to Alternative 2s because the partial source mass removal component would remove more contaminant mass from the sources which could potentially reduce the overall duration of remediation, allowing for faster compliance. However, as stated in the previous paragraph, short term or long term reduction in CWS is not anticipated. Therefore, while compliance with ARARs is the goal of the remedy, it is not clear that this will be achieved at this time. Therefore, considering this is an IROD, the ARARs will be assessed again thru the entire process (e.g., at the completion of the respective remedial design, remedy implementation, first 5 year review, etc) to assess and determine if the remedy is compliant with the ARARs.

Primary Balancing Criteria

Long-Term Effectiveness and Permanence. Alternative 2s and 3s for all four source areas would provide long-term effectiveness and permanence to the same general degree through a combination of POUT at CWS, active treatment (eGWIS or eGWIS and PSMR), LTM, and LUCs. KWTP air strippers at CWS would effectively remove VOCs from drinking water as long as they operate. The treatment technology (air stripping) is well established to reduce VOCs to levels that are protective of human health. More specifically, to maintain an effluent concentration less than the drinking water standard (5 µg/L for TCE) in water produced from the KWTP, the influent concentration of TCE in CWS to the air strippers cannot exceed 400 µg/L (Tetra Tech, 2012) with the current system. Alternatives with a PSMR component (Alternative 3s) may slightly reduce the overall duration of remediation (40 to 100 years) compared to Alternative 2s

Reduction in Toxicity, Mobility, or Volume Through Treatment. Alternative 2s and 3s for all four source areas would achieve reductions in COC toxicity and volume through treatment. Alternative 3s are expected to achieve faster reductions within the source areas compared to reductions under Alterative 2s; however, such effect is expected to decline rapidly (generally decline exponentially) with time. In addition to active treatment (i.e., eGWIS or eGWIS and PSMR), reductions in toxicity and volume would also be achieved through POUT at CWS. Currently, KWTP removes approximately 500 pounds of TCE per year.

Short-Term Effectiveness. All of the Alternative 2s and 3s would reduce human health risks to acceptable levels over the short term to the same general degree because POUT at CWS would remove VOC COCs from the drinking water source and groundwater use restrictions would be implemented. Exposure of workers to contamination during installation of new extraction and injection wells, modification and operation of the eGWIS system, and groundwater sampling would be minimized by compliance with the Occupational Safety and Health Administration (OSHA) requirements, including wearing appropriate personal protective equipment (PPE) and adherence to site-specific health and safety procedures. Implementation of LUCs would not adversely impact the surrounding community or the environment.

In general, short-term effectiveness of all active remedial alternatives is expected to be similar, although estimated annual contaminant mass removal rates for alternatives with aggressive bioremediation are expected to be two to five times greater than those for alternatives with eGWIS only. However, it will likely be difficult or impossible to observe and measure the impact of this increase in contaminant mass removal due to the scale, complexities, and uncertainties of the site.

Implementability. Alternative 2s would be difficult to implement because of extensive modifications to the existing treatment process, new extraction wells with underground connections, and modifications of the existing underground piping network. However, the impact would be limited because the length of new piping connections to the new extraction wells would be small compared to the existing underground piping network. In addition, modification to the eGWIS treatment facility is expected to pose no additional impacts to future development. Comparing the implementability of Alternative 2s in the four source areas, the installation of new extraction wells and associated piping connections would not be feasible in the Industrial source area because it is the most developed area with the most activity. However, as ANAD's mission changes in the future and access is granted in the Industrial Source area the installation or modification of extraction wells will be reconsidered on a case by case basis. The installation of new extraction wells and associated piping connections would be possible in the Northeast Area, followed by the Trench Area, then the Landfill Area due to the different levels of development in these areas.

Alternative 3s would be the most difficult to implement because of the added PSMR components, which would require installation of multiple injection wells and extensive underground connections to the injections equipment compound. The alternatives with the added PSMR components would have an additional impact on future development of the site to varying degrees, depending on the sizes of the source areas. However, the additional impact on future development of the site due to the added injection wells would be limited because the areal extent of the source areas is small in relation to the size of the site. The degree of difficulty in implementing the PSMR components is expected to increase with an increasing number of injection wells in a particular source area. The PSMR system would be the most difficult to install in the Northeast Area where approximately 66 injection wells would be required. The injection wells and associated piping connections would be easier to install in the Trench Area (41 approximately injection wells) and the easiest in the Landfill Area (approximately 27 injection wells).

Long-term LUCs would be required for all Alternative 2s and 3s until RAO No. 4 is achieved; therefore there is no difference between Alternative 2s and 3s in terms of the implementability of the LUC component. Because most LUCs are already in place, it is expected the LUCs would be relatively easy to implement.

Cost. The estimated present-worth costs for the alternatives are identified in Tables 2-9.

Modifying Criteria

State Acceptance. State involvement has been solicited throughout the CERCLA process. ADEM has indicated its support for Alternative 3 for the Landfill Area, Trench Area, and Northeast Area and Alternative 2 for the Industrial Area.

Community Acceptance. The 30-day public comment period for the Proposed Plan for OU-1 began on October 15, 2012, and ended on November 15, 2012. A public meeting was held on October 23, 2012, to accept oral and written comments. In this meeting and written comments, there were statements from Mr. Grant, Mr. Miller, Mr. Frazier, and Mr. Smith that were critical of the cost of the implementation of the preferred alternative considering the time frame to achieve remediation. They generally questioned the continued value of further remediation at OU-1. While consensus was not requested, it does not appear that the community is supportive or has acceptance of the Proposed Plan due to the long clean-up timeframes and associated cost represented by the predictive modeling. Please refer to Section 3 for additional information on the comments provided and Appendix A for additional information on the determination of cleanup times.

2.11 PRINCIPAL THREAT WASTE

The NCP at 40 CFR 300.430(a)(1)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or that would present a significant risk to human health or the environment should exposure occur. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure.

Chlorinated solvents in DNAPL source zones are considered principal threat wastes. For OU-1, although DNAPLs were not found during investigations, they may exist at the site according to EPA's rule of thumb, which states that DNAPL is likely present if the groundwater concentration of a particular contaminant exceeds 1 percent of its pure phase or effective solubility (EPA, 1992). Therefore, it was decided by the ANAD Partnering Team in 2011 that a source zone at the SIA is defined as an area with TCE concentrations greater than 10 mg/L in groundwater. Chlorinated solvents in the defined source zones at SIA are considered "principal threat wastes" and shall be addressed. All of the active alternatives (Alternative 2s and 3s) would address the principal threat wastes at OU-1.

2.12 Amended Interim Remedy

2.12.1 Rationale for Amended Interim Remedy

The Amended Interim Remedy for OU-1 is a combination of Alternative 3 for the Landfill Area, Trench Area, Northeast Area and Alternative 2 for the Industrial Area. These alternatives were selected because they provide the best balance of tradeoffs with respect to the nine evaluation criteria. The Amended Interim Remedy will be protective of human health and the environment and comply with ARARs. Note that risks associated with the Pygmy Sculpin in Coldwater Spring are currently being evaluated and will be addressed later as an amendment to the IROD or ESD (Section 2.7.2), as appropriate.

The principal factors in the selection of this remedy included the following:

- The Amended Interim Remedy includes state-of-the-art technologies for a complex site containing DNAPL.
- The combination of remedial technologies would potentially accelerate the normally long-term remedial processes associated with DNAPLs while remaining protective of human health and the environment.

2.12.2 Description of Amended Interim Remedy

Alternative 3 for the Landfill Area, Trench Area, and Northeast Area includes five major components: (1) POUT at CWS, (2) eGWIS, (3) aggressive bioremediation in each source zone, (4) LTM, and (5) LUCs. Alternative 2 for the Industrial Area includes four major components: (1) POUT at CWS, (2) eGWIS, (3) LTM, and (4) LUCs. The POUT, LTM, and LUC components described below applicable to all four source areas.

The POUT component is to maintain and potentially optimize the KWTP at CWS. The KWTP currently uses six air strippers to treat VOCs in influent water to provide clean drinking water to the public. The KWTP does not treat the VOCs in CWS. The design capacity is a total of 23.5 million gallons per day (gpd) for the six air strippers. If setting the effluent concentration limit as the drinking water standard of 5 µg/L for TCE the maximum allowed TCE concentration in the influent is 400 µg/L. However, based on the Alabama Water Quality Criterion, TCE concentrations in surface water being used for a public supply cannot exceed 2.4 µg/L. Therefore, the maximum allowed TCE concentration in the influent would need to be less than 400 µg/L and the allowed maximum TCE concentration would be calculated in the remedial design (RD) phase. If the amount of water to be treated increases or the influent concentrations increase to greater than the allowed maximum concentration, upgrade/optimization of the KWTP would be needed.

The LTM component includes monitoring contaminant concentrations over time to determine the trends. A groundwater monitoring program would be developed and implemented to track COC concentrations over time and evaluate natural attenuation processes. Monitored Natural Attenuation (MNA) parameters (e.g., nitrate/nitrite, sulfate/sulfide) would be included, as needed, in the analyte list, in addition to the primary contaminants. A detailed monitoring program, including the frequency of collecting MNA parameters, would be developed in the RD phase.

The site-wide LUCs, which will be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure, will be the same for all four source areas and will include the following aspects:

- The Army would continue to apply groundwater use restrictions within the SIA to prohibit use of groundwater for drinking or irrigation purposes. This restriction would be incorporated into ANAD's Master Plan and any LUC Implementation Plans, in accordance with the SIA groundwater or SWMU-specific LTM and/or RDs.

- Land use planning procedures would be incorporated into ANAD's master planning process, inspections, construction-permitting requirements, and monitoring.

- The Army is responsible for maintaining, monitoring, reporting on, and enforcing the LUCs.

- The Army would continue to maintain the fence and signage to the ANAD facility.

- Advisories would be issued by the Army to provide notice to potential off-base users of groundwater (e.g., private well owners) of the risk associated with groundwater use.

- A LUC Remedial Design will be prepared as the land use component of the Remedial Design. The Army will establish a milestone for submittal of this LUC RD, generally within 90 days of the finalization of the ROD, and shall prepare and submit to EPA and ADEM for review and approval a LUC RD that contains implementation and maintenance actions, including periodic inspections.

The eGWIS component would be a pump and treat system for the entire SIA with extraction wells placed in the source zones and a centralized treatment facility to treat the extracted water. The treated water will be mixed with the other wastewater streams of the site [i.e., effluent from the Industrial Wastewater Treatment Plant (IWTP), Sewage Treatment Plant (STP), and Building 114 treatment system], and the co-mingled effluent will be discharged to Choccolocco Creek in accordance with ANAD's National Pollutant Discharge Elimination System (NPDES) permit. Note that eGWIS and Building 114 treatment systems will continue to operate independently. The primary reason for this is that the Building 114 sump is intended as a dewatering system which allows that specific building to support the ANAD's mission and because of the unique treatment system in place. Even if the eGWIS was terminated, the Building 114 system will operate to support the mission of that building.

The eGWIS would include a re-design of the current GWIS to focus on mobile mass extraction focusing in the upper portion of the weathered bedrock. Redesign and optimization of the current GWIS will include optimizing the number and locations of pumping wells, pumping methodology, and ex-situ treatment process for extracted groundwater. Extraction wells will be placed in the source zones. Both existing extraction wells and new wells would be considered for the eGWIS. Based on the conceptual design presented in the FFS, it is expected that the Landfill Area, Trench Area, and Northeast Area will each use one existing and two new extraction wells for the eGWIS. For the Industrial Area, four new extraction wells will be installed and used for the eGWIS. The design will be finalized during the Remedial Design phase.

The eGWIS will be continuously optimized and ultimately terminated if the exit criteria discussed in Section 2.13 are met.

Aggressive bioremediation will be conducted in the source zones through arrays of new injection wells. Based on the conceptual design in the FFS it is expected that, 66, 41, and 27 injection wells will be installed in the Northeast Area, Trench Area, and Landfill Area, respectively. The design will be finalized during the remedial design phase. Aggressive bioremediation will not be conducted in the Industrial Area due to significant implementability and access limitations. However, if operations in the Industrial Area change and if access can be obtained, partial source mass removal will be implemented, as necessary. Amendments will be injected into the upper residuum unit, and the extraction wells (as a part of the eGWIS), along with the natural primary ground water direction, will pull the injected amendments in a downward direction through the residuum unit. Aggressive bioremediation will be operated per the criteria discussed in Section 2.13.

2.12.3 Expected Outcomes of Amended Interim Remedy

Implementation of the Amended Interim Remedy will provide immediate protection of human health and achieve RAOs 1 through 3 in the short term. RAO No. 4, i.e., returning usable groundwater to its beneficial uses wherever practicable, will be achieved in the long term. Given the level of complexity of this site, the time to reach MCLs in all areas is likely to be very long, in the range of several hundred to several thousand years, as shown in Table 2-9. Despite the anticipated long time frame the overall objective is to reduce contaminates in groundwater to MCLs. Please see Appendix A for additional information about anticipated cleanup times. For additional information regarding comparisons between the current remedy and the amended interim remedy, refer to FFS dated April 2012 in Sections 2.3.3, 6, and 7.

2.13 AMENDED INTERIM REMEDY OPERATION OR TERMINATION CRITERIA

The Army, ADEM and EPA determined during the FFS for OU-1 that an Amended Interim Action was required to address contamination in groundwater (Tetra Tech, 2012b). This IROD Amendment will institute modifications to the existing IROD which is intended to prevent further migration of contaminants and/or foster environmental degradation of the contaminants present. An interim action is limited in scope and only addresses areas/media that also will be addressed by a final OU ROD (EPA, 1999). As discussed in Section 1.5 the estimated long time of remediation is the driver behind an IROD Amendment. The Amended Interim Remedy is a multi-pronged approach to address end-user risk and to attempt to comply with EPA's programmatic expectation that treatment will be used, to the extent practicable, for groundwater response actions (40 CFR 300.430(e)(4)). This multi-pronged approach includes POUT, LTM, and LUCs for end-user protections and eGWIS and partial source mass removal for source treatment. This section describes the operational parameters and criteria for which components of the remedy to operate and subsequently be terminated (i.e., discontinued). It is the intention of the Army that the remedy proposed will lead to a final ROD.

The POUT, LTM (continually optimized), and LUCs components will be implemented until all four RAOs are met. The Army, ADEM, and EPA have determined the following operational or termination criteria will be implemented for eGWIS and partial source mass removal. These technologies will be reviewed after a 5 year timeframe in accordance with Section XX of the FFA (1990).

2.13.1 eGWIS Operation or Termination Criteria

1. The eGWIS will be continuously optimized and ultimately terminated, if the primary criterion of achieving TCE groundwater concentrations is consistently less than 10 mg/L is achieved, or
2. If the criteria below are met based on a weight-of-evidence (WOE) approach (given that the system has been fully optimized):
   a) Asymptotic contaminant mass removal, as illustrated by a WOE approach considering the following:
      - Mass removed versus time
      - Mass removed versus cost per pound
      - Mass removed versus gallon of water removed
      - Inflection point between cost and mass removed is exceeded
   b) Low contaminant mass removal rates compared to mass discharge
   c) Biological destruction in the source area exceeds mass extracted as quantified by mass removed versus cost per pound

d) Established steady-state conditions via natural attenuation as confirmed by LTM data (“replacement” of mass extracted by eGWIS with natural attenuation destruction)
e) Extraction system inhibits natural attenuation (e.g., induction of aerobic water into the subsurface)

The Army will conduct the above analysis and will submit the result to ADEM and EPA for review and concurrence in accordance with the submittal of primary documents in the FFA (1990). The report will address the above factors and will include a recommendation regarding the eGWIS system, including a recommendation whether to terminate the system and/or the continued operation of an individual well (s). If concurrence cannot be reached, then the parties will follow the process defined in the FFA (1990) for invoking dispute resolution.

2.13.2 Partial Source Mass Removal Operation or Termination Criteria

Performance data collected during implementation of the Amended Interim Remedy will be used to determine the partial source mass removal’s effectiveness and its impact on CWS. The partial source mass removal will be optimized on a continuous basis to maximize performance within criteria defined below. At the end of the fifth year of active partial source mass removal operation, the system will be evaluated to determine its impact on TCE concentrations in CWS and therefore provide the basis for its continuation or termination. Figure 2-6 illustrates a decision flow chart that will be utilized to determine the effectiveness and the operational fate of the partial source mass removal system. Its fate is primarily based on concentrations in CWS and secondarily the concentrations in monitoring wells downgradient of the source areas. In short, if over this five year period concentrations in CWS (1) decrease below 2.4 µg/L (Alabama Water Quality Criterion for TCE concentrations in surface water for a public supply); (2) exhibit a decreasing trend, and (3) the time of remediation is significantly reduced from the time of remediation in the FFS then the partial source mass removal will be evaluated for inclusion in the ROD. Conversely, if these criteria are not met, then the partial source mass removal will be terminated after the 5 year period of operation. The time of remediation shall be calculated in the same manner as done in the FFS so that a direct comparison can be made in the remedy effectiveness (refer to Appendix A and Appendix F of FFS). The contaminant mass shall be refined based upon additional data collected in the pre-design and remedy implementation phases. The monitoring wells and the sampling frequency will be defined in the remedial design phase. The details for this evaluation process are shown in Figure 2-6. Appendix B gives a detailed description of each box in the flow chart along with definitions of statistically terms used.

Operation of the partial source mass removal may be terminated before 5 years of operation if one or more of the following two conditions are met:

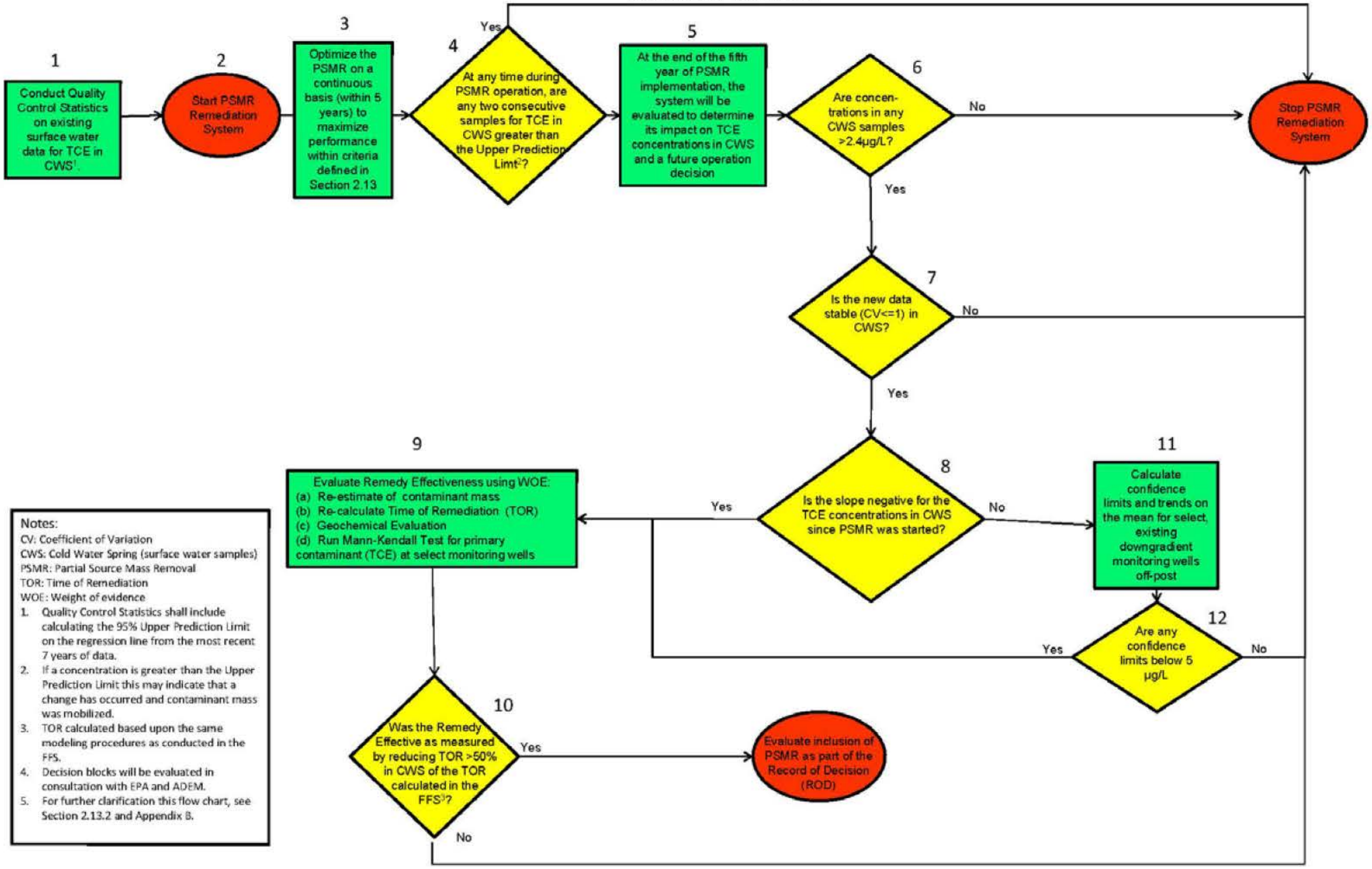
- Favorable geochemical conditions for reductive dechlorination in the respective source area(s) are sustained based on a WOE approach including parent to daughter product ratio relationships, geochemical and/or molecular biological tools data indicates the biological system is self-sustaining;
- The mass removed in the respective source area(s) by the partial source mass removal system exceeds two times the amount of mobile source mass term (which is defined as the dissolved mass plus sorbed mass) indicating that **immobile** mass is being treated which is not the intent of the partial source mass removal (Tetra Tech, 2011 and 2012b). The mobile source mass term will be calculated in the same manner as done in the FS (SAIC, 2008a) and TM 3 (Tetra Tech, 2010) so that a direct comparison can be made in the remedy effectiveness;

OR

- The concentration in CWS increases sharply and data indicate that mobile mass has been released from the source area(s) (see box 4 of Figure 2-6).

The Army will conduct the above analysis and will submit the result to ADEM and EPA for review and concurrence in accordance with the submittal of primary documents in the FFA (1990). The report will address the above factors and will include a recommendation regarding the termination of the PSMR system. If concurrence cannot be reached, then the parties will follow the process defined in the FFA (1990) for invoking dispute resolution.

Figure 2-6
PSMR Termination
Decision Flow Chart



Notes:
CV: Coefficient of Variation
CWS: Cold Water Spring (surface water samples)
PSMR: Partial Source Mass Removal
TOR: Time of Remediation
WOE: Weight of evidence

1. Quality Control Statistics shall include calculating the 95% Upper Prediction Limit on the regression line from the most recent 7 years of data.
2. If a concentration is greater than the Upper Prediction Limit this may indicate that a change has occurred and contaminant mass was mobilized.
3. TOR calculated based upon the same modeling procedures as conducted in the FFS.
4. Decision blocks will be evaluated in consultation with EPA and ADEM.
5. For further clarification this flow chart, see Section 2.13.2 and Appendix B.

2.13.3 Final Record of Decision

Following 5 years of remediation and monitoring per this IROD Amendment, the Tier I Partnering Team will reconvene to discuss more permanent remedial options, including the potential to implement a final ROD. The partial source mass removal will be evaluated, based upon criteria in Section 2.13.2, to determine if it should be carried forwarded in the final ROD.

The final ROD will continue to address the end-user risk at CWS. Subsequent statutorily required five-year reviews will continue to review data and to analyze whether partial source mass removal will have a measurable impact on the end-user risk associated with contaminated groundwater. This will continue with or without the operation of the partial source mass removal beyond the 5 year period.

2.14 STATUTORY DETERMINATIONS

In accordance with the NCP (40 CFR 300.430(f)(1)), the Amended Interim Remedy meets the following statutory determinations:

- **Protection of Human Health and the Environment** – The Amended Interim Remedy will provide protection of human health and the environment via the use of POUT and LUCs. Note that risks associated with the Pygmy Sculpin in Coldwater Spring are currently being evaluated and will be addressed later as an amendment to the IROD or ESD (Section 2.7.2), as appropriate.

- **Compliance with ARARs** – The amended interim remedy will comply with all of the ARARs as presented in Table 2-3 with the following exception. It will not meet the MCLs for the contaminants identified in Table 2-6 due to the interim nature of this action. CERCLA Section 121(d) provides that all remedies will meet all applicable and relevant and appropriate requirements, with limited and specific exceptions. One of those exceptions, found at CERCLA Section 121(d)(4)(A), applies at OU-1; this exception allows for certain requirements to not be met where it is found that the remedial action is only a part of a total remedial action that will attain those requirements in the final action.

- **Cost-Effectiveness** – The Amended Interim Remedy may not be the most cost-effective alternative that complies with all associated ARARs and protects human health and the environment, considering the uncertainty in the contribution of PSMR to downgradient receptors and to the cleanup time frames and the criteria for establishing cost effectiveness in the NCP, 40 CFR 300.430(f)(1)(ii)(D). However, the parties have agreed to this approach in order to gather more data and utilize the most current technologies in an effort to significantly reduce the risks posed by the site.

- **Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** – The Amended Interim Remedy includes the state-of-the-art technologies for a complex site with potential DNAPL. Although the Amended Interim Remedy is not designated or expected to be final, it represents the best balance of trade-offs among alternatives with respect to the NCP balancing and modifying criteria, while also providing an additional 5 years worth of data to help support a final ROD. Specifically, compared to the other active alternatives, the Amended Interim Remedy is expected to provide better short-term effectiveness through implementation of PSMR and received support from the State.

- **Preference for Treatment as a Principal Element** – The Amended Interim Remedy uses treatment (i.e., eGWIS and partial source mass removal) to support the preference for treatment as a principal element. The preference will be addressed in the final ROD for OU-1.

- **Five-Year Review Requirement** – Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of this amended interim action remedial action and every 5 years thereafter to ensure that the interim remedy is, or will be, protective of human health and the environment [in accordance with CERCLA 121 (c)].

2.15 DOCUMENTATION OF SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of significant changes from the Amended Interim Remedy presented in the Proposed Plan that was published for public comment. The public comments received are included in Section 3. No significant changes to the remedy, as originally identified in the Proposed Plan, were deemed necessary after addressing the public comments.

3.0 RESPONSIVENESS SUMMARY

3.1 STAKEHOLDER COMMENTS AND LEAD AGENCY RESPONSES

The 30-day public comment period for the Amended Interim Remedy for OU-1 began on October 15, 2012, and ended on November 15, 2012. A public meeting was held on October 23, 2012, to accept oral and written comments on this decision. The following sections summarize the written and oral comments received from the public and the Army's response.

3.1.1 Written Comments and Responses

Comments Received from Mr. Ron Grant:

1. "Reference page 2: The diagram of "the CERCLA Process" is too small to be readable. It needs to be enlarged and put on another page."

   Response: The comment is noted. In the future, when submitting documents for public review, figures will be made larger to be more easily readable.

2. "Reference page 4: In the paragraph "Historical Site Investigations," add a reference to the page number to the reference to "History of Site investigations and Interim Actions."

   Response: The comment is noted. In the future, when submitting documents for public review, additional references will be added to make the documents more easily readable.

3. "The reference to monitoring of "private offsite water supply wells" is not accurate; monitoring began prior to 2000."

   Response: Private off-site wells were sampled prior to 2000. The statement in the Proposed Plan refers to the 66 private wells that are in areas bordering ANAD and whose residents use their wells as a sole source of drinking water. In 2000, these wells became part of an annual sampling program to ensure the safety of off-site receptors.

4. "The reference to the GWIS, states the air stripping treatment system provides "clean potable, drinking water" to the community. This is inaccurate; it removes VOC's but does not treat bacteria, add fluoride, etc."

   Response: The comment is noted. The intent of this statement was to indicate the removal of TCE from the groundwater, not that the air strippers treat bacteria or add fluoride to the drinking water supply. Please contact the Krebs Water treatment plant for their procedures on bacteria treatment and inclusion of additives such as fluoride. These items are not part of this effort.

5. "A reference to Figure 2 refers to it as a "block diagram." Figure 2 is not a block diagram; it is a cross-sectional groundwater flow diagram that needs considerable improvement. What area is depicted? Is that Cold water Spring on the left?"

   Response: The comment is noted. In the future, when submitting documents for public review, additional descriptions of the figures in the reports will be included to make the documents more easily readable.

6. "Reference pages 15-18: The dark blue coloring in the right hand columns makes the information printed therein unreadable."

Response: The comment is noted. In the future, when submitting documents for public review, the font and coloring will be made clearer to improve readable.

7. "On page 15, none of the alternatives appear to improve on the 3,400 year timeframe of "No Action" What benefit is there to the $4.73M preferred alternative?"

   Response: The comment is noted and the Army is well aware of this observation. CERCLA requires a remedial action be taken if the Human Health Risk Assessment identifies an unacceptable risk to human health or the environment. The Army is planning to execute the best available technology despite the limited expectation of reducing the cleanup time. The Amended Interim Remedy chosen is the most appropriate state-of-the art technology to best achieve the RAOs. Unfortunately, due to the complexity of the site geology and hydrogeology, mass of contaminants, there are technological limitations on what can be done and the resulting effectiveness limitations. Until more data can be collected about the effectiveness of the best available technology, the partnering team will not agree on implementation of a technical impractibility waiver. The IROD will include optimization of the remedy and more importantly, evaluate and identify as new technologies become available to better address this problem. Concurrently, at the end of 5 years of operating the Amended Remedy, the Army will reevaluate the conditions and determine the proper course of action for a final ROD.

8. "On page 16, the most aggressive treatment reduces the clean-up time from 180 years to 160 years, approximately 11% improvement at a cost of $5.79M."

   Response: The comment is noted. As stated in Section 1 of the IROD, the Army is required to perform the remediation of OU-1 legally under CERCLA. The Selected Remedy chosen is the most appropriate to aid the Army in achieving the remedial action objectives. Please see response to comment number 7.

9. "On page 17, the preferred alternative reduces the clean-up times from 1600 to 1500 years, approximately 6% improvement at a cost of $6.81M."

   Response: The comment is noted. As stated in Section 1 of the IROD, the Army is required to perform the remediation of OU-1 legally under CERCLA. The Selected Remedy chosen is the most appropriate to aid the Army in achieving the remedial action objectives. Please see response to comment number 7.

10. "On page 18, the preferred alternative recues the clean-up times from 990 years to 950 years, approximately 5% improvement at a cost of $5.68M."

    Response: The comment is noted. CERCLA requires a remedial action be taken if the Human Health Risk Assessment identifies an unacceptable risk to human health or the environment. The Selected Remedy chosen is the most appropriate to aid the Army in achieving the remedial action objectives. Please see response to comment number 7.

11. "How much have we spent on the Installation Restoration programs at ANAD?"

    Response: To date the Army has spent around $70,000,000 at ANAD. More specifically around $35,000,000 has been spent at OU-1.

12. "What are the successes"

    Response: The Army feels that the entire IRP to date at ANAD has been successful. More specifically, the Army acted to provide the air stripper towers for the Krebs Treatment Plant to treat the TCE found in CWS. The proposed remedy is expected to be protective of human health and the environment.

13. “What are the failures?”

    Response: The Army feels that although there have been changes in the IRP, especially at OU-1, to date at ANAD, the IRP has had no failures. As noted in Response to Comment number 7, while we plan to implement the state of the art technology we recognize that the remedy will not reduce the cleanup time as compared to no action.

Comment Received from Mr. Walt Frazier:

“We are suppose to be good stewards and try and leave this world better than we found it. The health and safety of our citizens is our main objective. We’ve forgot all the principles of real estate the first being highest and best use of the land. Second location, location, location it where it is and that can’t be changed. In the matter of POUT (point of use treatment) at Coldwater Springs the levels are above drinking water standards and rising. When checking the records we find the levels at POUT below drinking water standards before relocation of Hwy 202. The esimates for cleaning it up are staggering, The air strippers that do take the TCE out of the water shouldn’t be our first and only line of defense. The intersection where this relocation of highway 202 is dysfuntional, lots of accidents, and some deaths. In 2007 when this road was relocated is the same year that the state of Alabama ended the long running employment discrimination lawsuit which cost the state over 206 million dollars and lasted over 20 years. There are no winners in a family fight and I’m praying that we can end this civil war now, it has cost too much already. The original 202 where the depot wants to put it’s main entrance is the area where the black community begins. In 1970 Mr. and Mrs. Semene Walker had there home built facing where the new 202 was to be build that’s been over forty years ago. This community has suffered long enough. Bynum Bldv. Won’t meet federal highway standards accidents occur at least three times per year from autos hydroplaning the last one on 13 August 2012. This auto ended up on it’s top. I’ve tried to no avail to get everyone to see that this is a safety issue. The state and Anniston Army Depot in it’s attempt to cover up the truth are now adding a turn lane which is going to take away the Springhill Baptist Church parking and not brig this road up to code. Enclosed is a letter from the East Alabama Regional Planning and Development Commision which states that four lane 202 would be a logical connection to improve peak hour traffic flow and safety. It’ll also divert the TCE from POUT at Coldwater Springs.”

Response: The comment is noted. As stated in Section 1 of the IROD, the Army is required to perform the remediation of OU-1 legally under CERCLA. The Selected Remedy chosen is the most appropriate to aid the Army in achieving the remedial action objectives. There is no plausible technical reason why the relocation of Hwy 202 has any meaningful impact on the fate and transport of TCE or other contaminants at ANAD.

3.1.2 Oral Comments and Responses

Comments Received from Mr. Garrett Smith:

“My comments are based on Page 15; and it was a comment as to the confidence in the system that we’re spending all this money on if we can’t put different numbers in the -- achieving of the cleanup objective in years. I feel like that, you know, if we have no more confidence in than that, then we don’t need to use it. And it is -- you know, it wouldn’t have insulted my sensibilities -- if you might say it that way so much if you had put “unknown” the last set, because you really don’t know. And it wouldn’t be –it would not be a question to what you’re doing, doing any good.

I really think that if you go back and change that, that my comment would be null and void. I don’t know whether you can or not. I don’t know whether you’re allowed to or not. But you don’t know.”

Response: As stated in Section 1 of the IROD, the Army is required to perform the remediation of OU-1 legally under CERCLA. As part of the remedial alternative evaluation in the FFS, the estimation of time frames to complete remediation is required and needs to be included in the evaluation process. Please see response to comment number 7.

3.2 TECHNICAL AND LEGAL ISSUES

All of the ARARs identified by the ADEM have not been included in Table 2-3, because the Army and EPA disagree with the ADEM's recommended ARARs.

No other technical or legal issues associated with OU-1 IROD Amendment were identified.

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APPENDIX A

SUMMARY OF GROUNDWATER MODELING RESULTS

Appendix A

Summary of the Modeling of Remediation Alternatives at the Anniston Army Depot (ANAD)

Modeling of the remedial alternatives was evaluated as a part of the Focused Feasibility Study (FFS) at the Southeast Industrial Area (SIA) of the Anniston Army Depot (ANAD). This appendix gives a summary of the modeling results and a discussion of how the modeling results should be used to evaluate effectiveness of the alternatives. The primary objective of the modeling was to estimate the length of time that trichloroethene (TCE) concentrations in the aquifer will remain above the maximum concentration limit (MCL) of 5µg/L. TCE was chosen as an indicator contaminant as it is the most commonly found and has the highest concentrations of any constituent at the SIA. A comparison of these times for various remediation alternatives is a means of estimating the relative effectiveness of the alternatives.

A computer model called REMChlor (Remediation Evaluation Model for Chlorinated Solvents) was used to contract the modeling. First the model was constructed and calibrated using site specific ANAD data then the model was run to determine time of remediation (TORs). The results present a range of remediation times. This range is appropriate as the model and the site data do not provide sufficient detail to accurately represent the site complexities to the extent that an absolute cleanup time can be determined.

For the modeling efforts documented here, the results should only be used for comparison of alternatives. Uncertainty exists in any model as it a simulation of real conditions. Specifically, TOR is influenced by input parameter uncertainties (e.g., the initial mass estimates and dissolution rates), hydrogeologic site complexities (e.g., preferential groundwater pathway in fractured and faulted media, etc.) and the model limitations to simulate actual conditions. Therefore, the modeled TORs are not absolute (e.g. are not precise to the given year), but the model does provide sufficient confidence within an order of magnitude.

Efforts were made to manage the uncertainty for decision making purposes by investigating the sensitivity of the model results on input parameters. The modeled TORs were sensitive to three factors: 1) the initial source mass; 2) the source dissolution rates (i.e., the physical source decay); and 3) the plume decay rates. Best calibration scenarios with higher dissolution rates and plume decay constitute lower end of remediation timeframes and the best calibration scenarios using lower dissolution rates and no plume decay constitute the high end of remediation timeframes.

The model was run to consider a no-action alternative (i.e., Alternative 1), a base case involving current remediation effort (i.e., the Groundwater Interceptor System), an alternative with optimized/enhanced pump-and-treat system (i.e., the enhanced Groundwater Interceptor System Alternative 2), and an alternative with Partial Source Mass Removal and enhanced Groundwater Interceptor System (i.e., Alternative 3). The remedial efforts were assumed to be implemented in 2015 and run for 30 years for the eGWIS and 5 years for the PSMR system.

Table 1 summarizes the range of remediation timeframes based on these best calibration scenario model runs. The two model runs show similar clean-up estimates for Coldwater Spring (CWS).

Table 1. Range of time of remediation (years) (best calibration scenarios)

	Landfill	**Trench Area**	**Northeast Area**	**Industrial Area**	**CWS**
Base case	3421 - >10,000	170 - 1443	1629 - 1213	982 - 2286	415 – 430
Alternative 1	3429 - >10,000	180 - 1451	1641 - 1233	989 - 2288	423 – 446
Alternative 2	3401 - > 10,000	160 - 1422	1590 - 1090	953 - 2245	394 – 372
Alternative 3	3390 - 7900	160 - 1414	1533 - 829	889 - 2163	373 – 327

Refer to Appendix F of the FFS for a more detailed discussion on the modeling results.

APPENDIX B

SUMMARY OF FIGURE 2-6

Step 1: Quality Control Statistics (see Appendix B-2 for more details on the statistical methods) will be computed on the most recent 7 years of data. The Quality Control Statistics will include a least square regression line and an upper prediction limit of the line. The least square regression line is a modeling the relationship between Trichloroethene (TCE) concentrations and time. The Upper Prediction Limit is an estimate of the maximum concentration expected to happen if nothing changes. The Least Square Regression Line and Upper Prediction Limit will enable the team to determine if the partial source mass removal (PSMR) system has mobilized TCE mass or if the PSMR is having little or no impact on the amount of TCE contamination.

Step 2: PSMR Remediation System will be started.

Step 3: At any point in time the PSMR system may mobilize mass. Therefore the TCE concentrations will be continuously monitored.

Step 4: To determine if the PSMR system has mobilized the TCE mass and caused an increase in TCE concentrations TCE concentrations in Coldwater Spring (CWS) will be compared to the Upper Prediction Limit (see Appendix B-2 for details on the Upper Prediction Limit). An Upper Prediction Limit is the upper estimate in which a future estimate is predicted to fall. If two consecutive samples of TCE are greater than the Upper Prediction Limit (see Appendix B-2 for more details on the statistical methods) there is cause to believe that the mass of TCE may have become mobilized by the PSMR system and the PSMR system will be stopped.

Step 5: After five years of running the effectiveness of the PSMR system will be evaluated to determine if the PSMR system should continue to operate.

Step 6: The purpose of the PSMR system is to reduce concentrations of TCE to an acceptable level. If any concentrations in CWS are greater than 2.4 µg/L the PSMR system will not be considered effective and the system will be shut off.

Step 7: If concentrations of TCE are unstable (extremely variable) this may be an indication that TCE mass has been mobilized by the PSMR system and therefore the PSMR system would need to be stopped. The Coefficient of Variation (CV) is a normalized way of measuring the variability of the data (see Appendix B for more details). If the CV is greater than 1 this indicates that the data are potential unstable and that the PSMR system is not reducing the TCE concentrations and therefore the PSMR system will be stopped.

Step 8: If TCE concentrations are decreasing over time than the PSMR system is working. To determine if concentrations are decreasing a linear line (See Appendix B-2 for discussion of Regression line and the slope) will be fit to the data. The slope of the linear line describes the direction and the steepness of the line. A negative slope indicates that the line is decreasing and therefore indicates that the PSMR system is reducing the concentrations of TCE.

Step 9:

(a) If the re-estimated of the containment mass as done in the FS (SAIC, 2008a) and TM 3 (Tetra Tech 2010) shows the mass removed in the respective source area(s) by the partial source mass removal system exceeds two times the amount of mobile source mass term (which is defined as the dissolved mass plus sorbed mass) indicating that immobile mass is being treated which is not the intent of the partial source mass removal (Tetra Tech, 2011 and 2012b).

(b) The time of remediation will be calculated based upon the same modeling procedures as conducted in the FFS (Tetra Tech 2012a).

(c) The analysis will determine if favorable geochemical conditions for reductive dechlorination in the respective source area(s) are sustained. The approach will include parent to daughter product ratio relationships, geochemical and/or molecular biological tools data indicates the biological system is self-sustaining.

(d) If the slope of the least squares regression line indicates that concentrations are decreasing over time the Mann-Kendall Trend Test will be used to determine if the decreasing trend is meaningful or just the result of random variation (i.e, a statistically significant trend). Details of the Mann-Kendall trend tests are presented in Appendix B-2.

Step 10: As described in step 9 (b), the time of remediation will be calculated based upon the same modeling procedures as conducted in the FFS, Appendix F.

Step 11: If concentrations of TCE are not decreasing the next question is whether TCE concentrations in downgradient wells are being effected by the PSMR system. To obtain a conservative estimate of the average concentration an upper limit on the average will be calculated (see discussion of Upper Confidence Limits on Mean in Appendix B-2).

Step 12: If the conservative estimate of the average TCE concentration in existing downgradient monitoring wells is greater than 5 µg/L the PSMR system is not working to limit TCE concentrations and will be stopped.

Appendix B-2

Definition of Statistical Terms in Flow Chart

Boxes 1, 4, and 8

Regression line

Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. One variable is considered to be an explanatory variable, and the other is considered to be a dependent variable. A linear regression line has an equation of the form $\boldsymbol{Y = a + bX}$, where $\boldsymbol{X}$ is the explanatory variable and $\boldsymbol{Y}$ is the dependent variable. The slope of the line is $\boldsymbol{b}$, and $\boldsymbol{a}$ is the intercept (the value of $\boldsymbol{y}$ when $\boldsymbol{x} = 0$). The most common method for fitting a regression line is the method of least-squares. This method calculates the best-fitting line for the observed data by minimizing the sum of the squares of the vertical deviations from each data point to the line (if a point lies on the fitted line exactly, then its vertical deviation is 0). Because the deviations are first squared, then summed, there are no cancellations between positive and negative values.

Upper Prediction Limit on Regression line

A prediction interval is an estimate of an interval in which future observations will fall, with a certain probability (typically 0.95), given what has already been observed. The upper limit of the prediction interval is the larger half of the interval. The appropriate Upper Prediction Limit will be calculated following the recommendations of USEPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance (March 2009).

Box 7: Coefficient of Variation

The Coefficient of Variation (CV) expresses the standard deviation as a percentage of the average. The standard deviation is the typical or average distance a value is to the mean. If your data is more spread out (has more variability) then you will have a higher standard deviation. It's often difficult to interpret a standard deviation since it's based on the sample of data. Is a standard deviation of 12 high or is 0.20 high? If you know nothing about the data other than the mean, one way to interpret the relative magnitude of the standard deviation is to divide it by the mean. This is called the coefficient of variation.

For example, if the mean is 80 and standard deviation is 12, the cv = 12/80 = 0.15 or 15%. If the standard deviation is 0.20 and the mean is 0.50, then the cv = 0.20/0.50 = 0.4 or 40%. So knowing nothing else about the data, the CV helps us see that even a lower standard deviation doesn't mean less variable data.

Box 8: Slope of regression line

The slope of a regression line (b) represents the rate of change in y (TCE concentration) as x (time) changes. Because y (TCE concentration) is dependent on x (time), the slope describes the predicted values of y (TCE concentration) given x (time).

Box 9: Mann-Kendall Test

The Mann-Kendall Test is a trend test recommended by USEPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance (March 2009). The Mann-Kendall statistical test is a nonparametric test that can help identify changes in contaminant concentrations over time, for a minimum of four samples. This test cannot verify the rate at which concentrations are changing. The Mann-Kendall Statistic is calculated by comparing data sequentially. The contaminant concentration at time 1 is compared to the concentration at times

2 through 4, then the concentration at time 2 is compared to the concentrations at times 3 and 4, and the concentration at time 3 is compared to the value at time 4. If the contaminant concentration increases between two events, then a value of +1 is given. A value of -1 is given if the contaminant concentration decreases between two events and a value of 0 is given if the concentration does not change. The values representing the changes between the concentration at time 1 and other times are totaled, then the changes between time 2 and other times, and so on. The sums are all added together to get one value, which is the Mann–Kendall S Statistic.

The small sample Mann-Kendall statistical test is used to determine whether the contaminant concentrations are increasing, decreasing, or staying the same when the sample size is less than or equal to 10. For the small sample test, a Mann-Kendall Statistic Look up Table is used, which provides the p-value based on S statistic and number of samples. If the p-value is less the 0.05 ($\alpha = 0.05$) it is concluded that at the 5-percent significance level a trend is present. In order to state that there is a decreasing trend in the data, the value of S must be negative. For an increasing trend, S must be positive.

The large sample Mann-Kendall statistical test is used to determine whether the contaminant concentrations are increasing, decreasing, or staying the same when the sample size is greater than 10. For the large sample Mann-Kendall a normal approximate is used to calculate the p-value. If the p-value is less the 0.05 ($\alpha = 0.05$) it is concluded that at the 5-percent significance level a trend is present. In order to state that there is a decreasing trend in the data, the value of S must be negative. For an increasing trend, S must be positive.

Box 11 Confidence Limit on Mean

The confidence interval of the mean describes the range of values the true mean, or average, could fall in based on your data and confidence level. The most commonly used confidence level is 95 percent, which means there is a 95 percent probability that the true mean lies within the confidence interval. USEPA's ProUCL Software will be used to calculate the appropriate Upper Confidence Limit on the mean. ProUCL calculates the Upper Confidence Limit on the mean based on methods recommended by USEPA.